

POPULAR MECHANICS

FEB. 1971
50 CENTS

What's
New In
Pickup
Trucks

Build This 10-Foot Sailboat for \$200

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Daytona 500 Preview

Big Year for the Little Guys?

Exploring the Scenic New Arkansas Waterway



New, More Versatile Cassette Recorders

How to Raise the Roof On a Camper Van

A Working Model Live-Steam Tractor

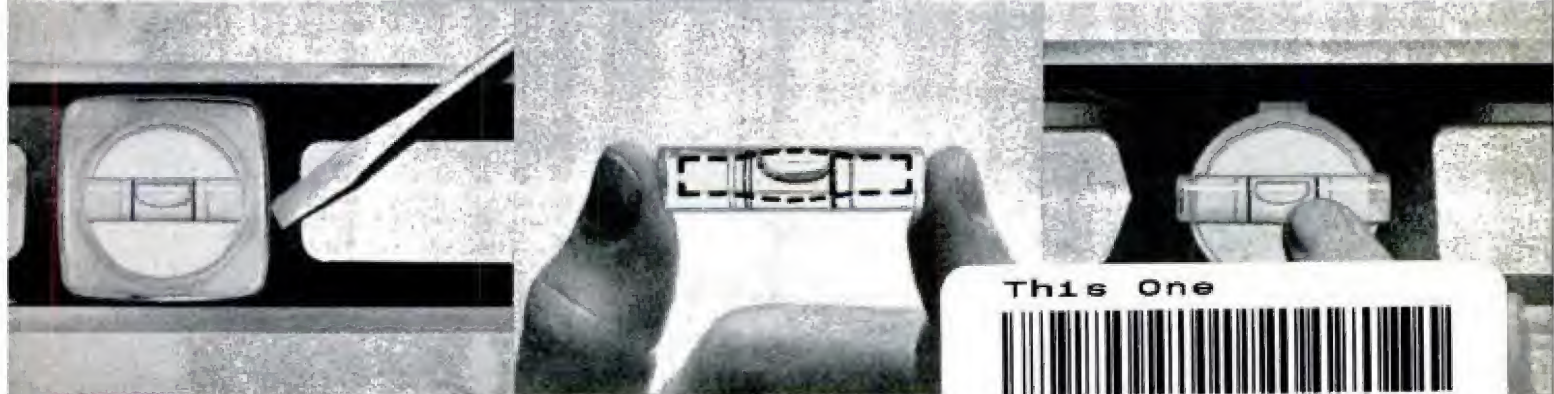
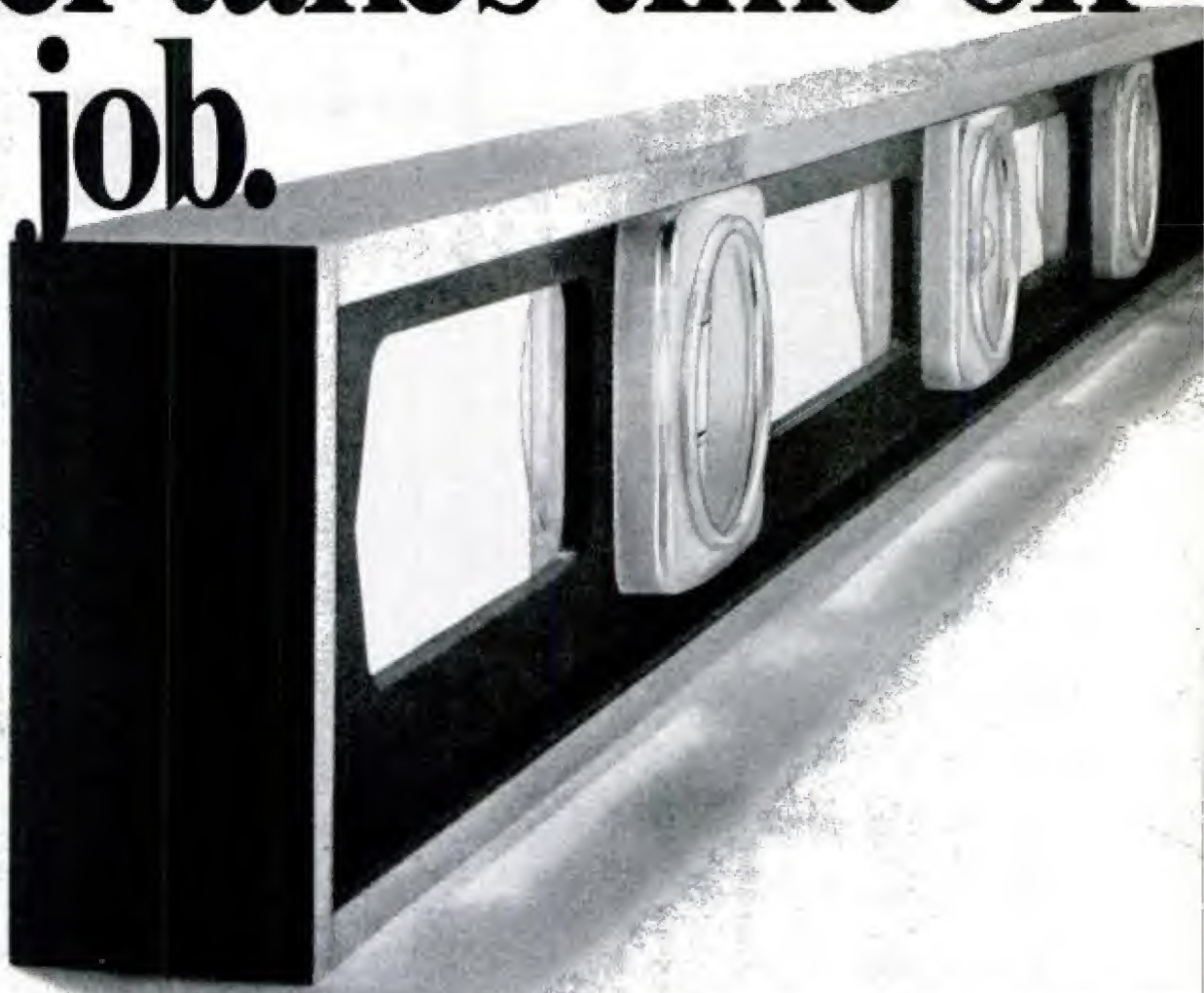


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Cover Photo by Elbert Witt

Build This 10-Foot Sailboat for \$200 (No building form is needed and it's light enough for cartopping)

NEXT MONTH IN POPULAR MECHANICS

The '71 Boats. Center consoles, jets, sails, new products—22 pages in all!
I'm Retiring . . . but I'll Never Quit Racing! Exclusive interview with Dan Gurney.
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Pinto vs Vega: A Coast-to-Coast Test. New bantamweights rack up 10,000 miles.

THIS MONTH'S CLASSIFIED ADVERTISING SECTION BEGINS ON PAGE 200

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LETTERS

TO THE EDITOR

F-15—too late?

Help! The Air Force's proposed F-15 fighter (*A Fighter Pilot's Fighter Plane*, page 75, Dec. PM) due to be operational in 1975 is a dead-ringer for Russia's MiG 23—in production and operational now!

The conclusions to be drawn from this fact are self-evident and fraught with dire forebodings for this country. While the Russians were planning decent, straightforward fighters, the USAF was sold Mr. McNamara's tricky, jack-in-the-box F-111 swing-wing whatzit. Top-heavy with complexities, expensive and difficult to produce, the F-111 was good only for defense industry contractors.

NEW YORK CITY RICHARD MARTIN

Great hints!

Your *40 Great Hints for Your Home and Shop* (page 156, Dec. PM) was great! Let's have more like it.

DAVENPORT, IOWA

H. NEIBERT

How about an index?

I think *Popular Mechanics* is the best. I have a couple of questions. Why don't you have a lifetime subscription rate that would save renewing every few years? And why don't you make an index issue in December that would cover all the articles and projects for the whole year? That way you won't have to look through every issue to find a particular article. I think these ideas would make the best magazine just a little bit better.

PATTON, PA.

GARY CHURELLA

In these days of computers, high production costs and rising postal rates, five years (for \$18) is the longest subscription we can offer. It's not a lifetime—but for 18 bucks it's not bad.

As for your second question: In December, we'll announce the availability of an inexpensive Annual Index (this one covering the year 1971) combined with an attractive shelf cover for all 12 issues.

Carib Queen

Congratulations on your very excellent description of *The Last Flight of the Carib Queen* (page 94, Dec. PM).

I just finished reading it, and haven't got my breath back yet. Let us hope the

(Please turn to page 8)

POPULAR MECHANICS

"Look who's smiling now!"

Sometimes a man sets his ambitions high enough to make skeptics smile. But how often he gets the last laugh! "At the time I started studying with LaSalle, I was working as a factory clerk. Before completing the course I was transferred to cost accounting and my salary was increased by \$1800. Now, having completed the course, I'm in charge of the department and headed for the five figure bracket. LaSalle's course helped me pull myself out of a boring and ill-paid job into a position of almost unlimited opportunity."

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Age.....

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LETTERS

(Continued from page 6)

story will help make further flights safer for all. Those pilots are really heroes.

SYRACUSE, N.Y. MRS. BEATRICE STURGE

Good water from bad

Whenever I am asked for advice and help on a water problem involving a private water supply, I refer the enquirer to *6 Ways to Make Bad Water Good* (page 184, May '69 PM). It is an excellent article and contains very helpful information.

MOUNT CLEMENS, MICH. ROBERT H. HANSEN
SUPT., WATER PURIFICATION AND PUMPING

How deep is the ocean?

In *Questions About the Oceans* (page 121, Nov. PM), your first two questions and answers contradict each other. If the greatest depth is 37,782 feet, then the greatest pressure would be around 18,000 to 19,000 pounds per square inch. Since there is no pressure except the weight of the water and the air above, a rough rule of thumb to determine water pressure in an open vessel—or river or ocean—is to multiply the depth in feet by one-half. At 3000 feet, the pressure would be something around 1500 p.s.i., not 8100 as stated in the article.

PASCAGOULA, MISS. B. L. WHITE

You say that the ocean's greatest depth is 37,782 feet. I have checked in a number of recently printed encyclopedias, and they indicate that this reading is incorrect. The most commonly agreed upon depth is 36,198 feet, in the Challenger Depth of the Marianas Trench, southeast of Guam.

WHITBY, ONT. VELLO VOOGJARV

The errors are explained and resolved in this letter from Robert W. Taber, head of the Production Control and Quality Assurance Branch of the National Oceanographic Data Center:

"I was interested to see the article in *Questions About the Oceans* based on the book of the same name by Harold W. Dubach and myself. Unfortunately, there were two factual errors in the first printing, on which your article is based.

"The deepest confirmed sounding of the oceans was made by the Soviet vessel *Vityaz*, which reported a depth of 36,200 feet in the Marianas Trench off Guam in 1959. The depth of 37,782 feet observed in 1962 by the British survey ship *Cook* in the Mindanao Trench near

the Philippines was later retracted as erroneous.

"In the second question, the pressure at a depth of 3000 feet is 1350 pounds per square inch, rather than 8100. This pressure is sufficient to squeeze a block of wood to half its volume so it will sink.

"These errors have been corrected in later printings and the 121-page book is still available from the Government Printing Office, Washington, D.C. 20402, at 55 cents for the paperback edition and \$2 for the clothbound edition. There are more than 100,000 copies in print.

Potshot at George

George Reiger must be stupid to publish such an article as *How to Keep Your Shooter's Eye Sharp the Year Round* (page 116, Dec. PM), about hunting pigeons, blackbirds, etc., the way our wildlife status is now. I am going to complain to *Popular Mechanics* about that article because of its sickness to kill helpless birds looking for food or a home. I hope he gets fired.

NORTH OLDMSTEAD, OHIO UNSIGNED

There! That'll keep old George on his toes.

Shop Guide

I'm writing concerning the *Popular Mechanics Shop Guide* which you advertised in your pages. I read your magazine in the braille edition, and, unfortunately, there was no price listed for the guide. Could you tell me how much they cost and if they're still available.

PITTSBURGH, PA. HERMAN ALLWEIN

I just received my Shop Guide set (No. B1252) today and am so pleased with it I want four more sets to give as gifts.

ENGLEWOOD, COLO. R. S. WILTSHIRE

The Shop Guide continues to be one of PM's most popular offerings. Yes, indeed, the Guide is still available at \$3.95 per set from Popular Mechanics, Dept. JL, 224 W. 57th St., New York, N.Y. 10019.

Those Japanese drivers

I read with great interest the article, *They Said I Was Crazy to Drive in Japan* (page 126, Oct. PM). The Sunny [Datsun] 1200 is a sharp-looking automobile. The Japanese automobile industry builds many fine, small cars. However, I take exception to the remarks by the author [PM editor Bob Crossley] about Japanese

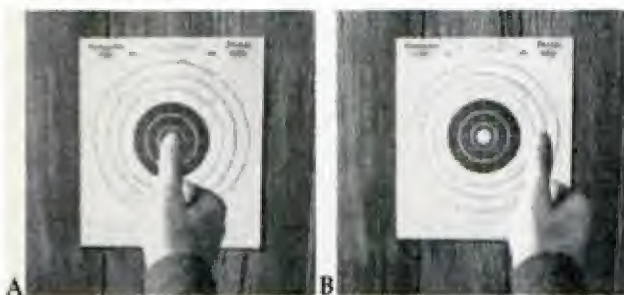
(Please turn to page 10)

Here's a left-hand shotgun some right-hand shooters should use.

Introducing the brand-new Remington Model 870 "Wingmaster" Left-Hand Pump Shotgun ... the only pump shotgun made with the ejection port located on the left side of the receiver.

The advantage this offers left-handed shooters is important: no more ejected shell hulls flying past his face. And this could be very important for some right-handed shooters as well!

How come? Because scientists have found that people tend to have a dominant or master eye. Just because you're right-handed, it does not automatically follow that your right eye is your master eye. It could be your left one.



Here's how to tell which is your master eye. If you're right-handed, hold out your right arm to its full length and sight with your thumb on some distant object, *keeping both eyes open* (see photo A). Now, close your left eye. If your thumb seems to move off target, (see photo B) then your left eye is your master eye. To check on it, close your right eye and open your left—without moving your hand. If your thumb is now back on target, it proves you used your left eye to sight with—even when both eyes were open.

Naturally, if your left eye is your master eye, you're better off using that one to shoot with even though you may be right-handed. If you're an experienced shooter, you may not want to learn new habits, but it's wise for beginners to learn to use their master eye. And the left-hand 870 is an easy gun to start with since the pump action can be operated with either hand. Incidentally, it's a good idea for parents to learn the correct master eye of their

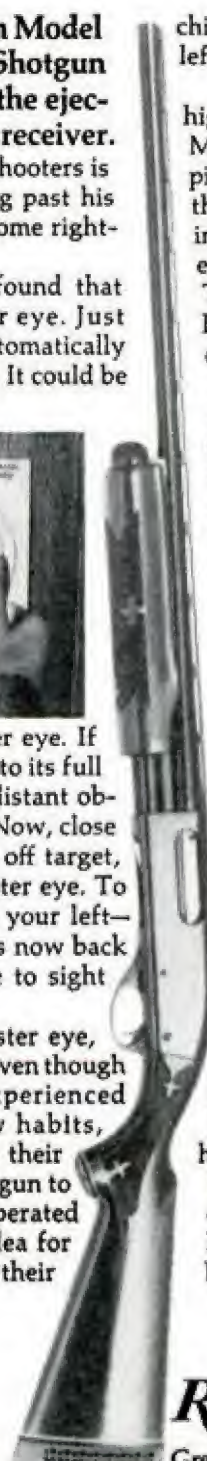
children before buying them their first gun. If they are left-eyed, this "Wingmaster" is the gun for them.

The new 870 is a good bet, because it meets the high standards of dependability set by the right-hand Model 870's. It has a receiver machined from a solid piece of steel. Double action bars permit you to pump the gun twice as smoothly—without twisting or binding. Exclusive "vibra-honing" finish makes the action easier to work and permits a deeper, richer blueing. The stock and fore-end have an exclusive Remington RK-W finish that will protect them against the rigors of the weather and the field for years.

The Model 870 Left-Hand Pump Action comes in both 12 and 20 gauge with optional barrel lengths of 26" improved cylinder, 28" full or modified, and 30" full chokes, plain or with ventilated ribs. There is also a 12 gauge magnum model with a 30" full choke with either a plain or ventilated-rib barrel. Both trap models are 12 gauge with a 30" full-choke ventilated-rib barrel, and one has a Monte Carlo stock.

Whichever model you select, we suggest that for best results you always use either "Remington" or "Peters" shotgun shells. Our testing procedure matches the guns and ammo to each other. In addition, you get the benefits of our famous "Kleanbore" non-corrosive priming for faster, surer ignition along with a clean, bright barrel. Our patented "Power Piston" one-piece wads deliver 10% more shot in the pattern area.

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LETTERS

(Continued from page 8)

drivers being skillful, law-abiding and courteous. They are skilled at driving recklessly. The author must have been very fortunate to meet drivers of the caliber he mentioned in his article.

I have lived in Japan for the past 18 months. I have driven in other countries, but Japanese drivers have to be the most impatient, oblivious in the world. They are constantly taking chances, such as passing on curves. The only group of drivers worse than taxi drivers are the so-called professional truck drivers. They literally plow through traffic by their sheer size, with their horns constantly blaring to clear a path.

YOKOHAMA

M. S. SMITH

Editor's note: I have also driven in any number of other countries, and the Japanese drivers I saw were skillful, law-abiding and courteous.—R.P.C.

Assistant Editor's note: On the other hand, Mr. Crossley himself may drive like a Japanese truck driver.—Anon.

Not in the garbage

The hint, *Eliminates Pail Cleaning* (page 193, Nov. PM), suggests throwing away waste crankcase oil.

Please don't discard any petroleum product by dumping it in the garbage. They are environmental pollutants and should be brought to an auto service station or oil company for disposal.

HARTSDALE, N.Y.

IRA GULKER, DDS

Candle stand

In *Holiday Candle Stand* (page 182, Nov. PM), there's a slight error in the plans. When you make an enlarged pattern of the arms, you should use half-inch squares instead of the inch squares that are indicated in the pattern. This way, it will turn out to be 8½ inches high.

LAMBERTVILLE, N.J.

RICHARD GOCCIA

Attention, Mongoose owners

I think your magazine is just great. I read it every month. I especially like your road tests on new cars. How about doing a test on a Mangusta Mongoose. I've heard it cruises at 140 mph and gets 28 miles per gallon.

SALINAS, CALIF.

BRENT BALL

Hmmm. We'll look into that one. Everybody who owns a Mongoose: Please send us a report.

★★★



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as an
**ACCIDENT
INVESTIGATOR**

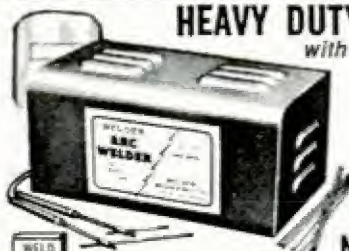
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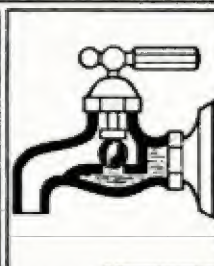
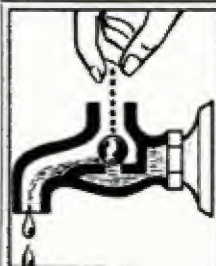
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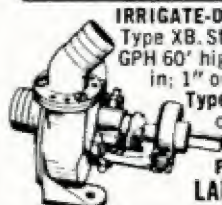
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The coming of the automobile built a multimillion dollar service industry in a few, short gas-eating years. The same thing has happened in the electrical appliance field. Manpower is desperately needed now to repair appliances.

But there is one big difference. Anybody with a few simple tools can get started in appliance repair. No expensive equipment is needed.

What is needed is the right kind of training. You can't strike it rich in today's job market with nothing more than muscle. Nor can you hang onto an old-time job skill while an electronic monster with buttons replaces men around you. It's like driving a buckboard down the Jersey Turnpike. The fuzz would locate you fast and send you out to pasture.

If you want an up-to-date job skill with good opportunity—why not take a look at the Electrical Appliance Repair field?

This field is loaded with opportunity because every house in our high speed land is loaded with appliances. There are about four times as many appliances as we have men, women, children and babies in the good old U.S.A. There are over a billion of these electrical gadgets being used, abused and broken. If you know how to do fast repair jobs on them, how much you can earn can well depend on how much you want to earn.

The opportunities in this field are all the better because you can prepare for them fast. There's one short, sweet course you can take right in your own home and it covers everything. I'm referring to a home-training course offered by the Appliance Division of National Radio Institute—one of the biggest and oldest home study schools of its kind.

NRI gives you the whole works. Their training covers basic electricity and how to use test instruments. They cover the electrical and mechanical operation of every type of appliance from toasters and coffee-makers to dishwashers; from vacuum cleaners and automatic laundry equipment to air conditioners and refrigerators. They even show you how to fix farm and commercial appliances and small one-lung engines.

The training is designed to be interesting, practical and fast. You can make \$5 to \$7 an hour extra fixing



appliances in spare time starting soon after you enroll. They give you all you need to know to do fast, profitable repair service. They even include equipment without charging you extra. And the full cost of the training is surprisingly low.

If you are driving a buckboard in today's job market, at least find out what the Appliance field can do for you. NRI sends you a fancy, illustrated book about their training so you can judge for yourself. There's no obligation and they don't send a salesman to pressure you. All I say is get the facts and see for yourself. Send the coupon today while you are thinking about it.

Tom McCahill

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BY ROB KINSON



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REPAIR YOUR SNOWMOBILE track or body at the point of breakdown with the new USM Snowmobile Repair Kit, which features a heavy-duty "Pop" Rivetool. This kit is packaged in a self-locking plastic carrying case and consists of the tool, interchangeable nosepieces and 200 steel or aluminum rivets in two lengths. Instructions are included for replacing broken drive-belt cleats as well as for repairing the vehicle's housing, cowling and underframe. For details, write USM Corp., Consumer Products Div., Box 1139, Reading, Pa. 19603.

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you don't even have to quit your present job!!!

Start learning now. At home, or in the garage, in your spare time — no outside classes to attend. If you can tie a knot and drive a tack, you can learn this business, quickly, easily. You start learning the basics right away through the proven MUI Home Training Plan. And before you're barely into it, you can start doing the simple upholstering jobs that are all around you waiting to be done. Chairs, cushions, seats, footstools. Even before MUI students finish their training, people start bringing upholstering jobs to them, and remember—the world is full of furniture that needs fixing and re-upholstering and more is wearing out all the time!

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Yes, many MUI graduates make better than \$10 an hour turning old wornout furniture into bright new decorator pieces! **Stack it up against what you're doing now!** Are you making \$150 a week? \$200? \$250? Do you put in long hours of dull work, with small raises? Is that the way you want to spend the rest of your life? Just imagine, you can make \$150, \$200, \$250 upholstering just one chair or sofa these days! And if you're the kind of person who likes to work and earn, you can sometimes finish a job like this in a day. That's pay... and it beats what most college graduates make!

AS YOU LEARN, YOU JUST SLIP INTO THE IMMENSE FLOW OF UPHOLSTERY WORK! Think of all there is! . . . Sofas, lounging chairs finished in beautiful fabrics, which MUI tells you how to get at the right price — even leather and all the new vinyls. And then you have built-ins and breakfast nooks, boats, trailers and all the millions of automobiles in America. Yes, you learn all this and more! When we finish teaching you, (in your own home in your spare time) and when you get our California state approved diploma, you know this business . . . as a real professional! You will then have one of the most fantastic moneymaking skills in America built into your head and hands! No one can ever take this skill away from you . . . and no one can ever fire you, because you're the boss of a business that you can take with you . . . You can make big money from then on . . . any time, anyplace you want to put out your shingle!

When you read the papers you see there's a strike here, a lockout there. Detroit lays off 150,000 men. A plant is shut down and moved out of state. A new automated machine eliminates 5,000 jobs. They talk about dislocated workers and try to do something about it. What pays the bills if you get caught up in one of these situations? When you know upholstering, life gets very simple and lots of fun. It's simple because where there are people, there are upholstery jobs and lots of them. It's fun because life is fun when the bills are paid and there's money in the bank, even enough to buy those things you've always wanted for yourself.

MUI IS APPROVED BY THE CALIFORNIA SUPERINTENDENT OF PUBLIC INSTRUCTION AND IS AUTHORIZED TO ISSUE A DIPLOMA IN UPHOLSTERY.

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FEBRUARY 1971

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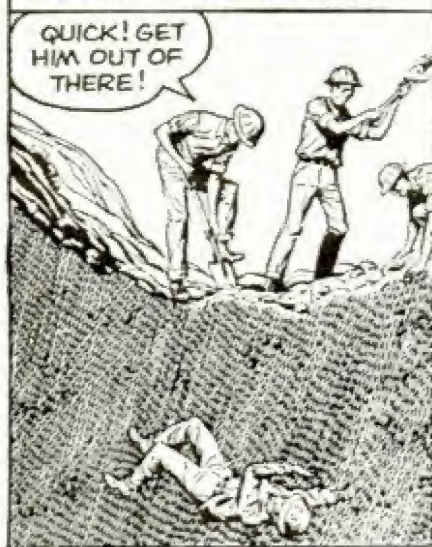
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SIX YEARS ON THE SAME JOB WITH NEVER AN ACCIDENT... AND THEN ONE MORNING...

2 A CAVE-IN PUT ME SIX FEET UNDER FOR SIX LONG MINUTES



3 IN THE HOSPITAL, I HAD PLENTY OF TIME TO THINK



SIX YEARS I'VE BEEN BURIED ALIVE IN THAT SAME OLD JOB, JANE!

WELL, NOW'S A GOOD TIME TO DO SOMETHING ABOUT IT

4 I'D PASSED OVER DOZENS OF I C S ADS IN POPULAR MAGAZINES. BUT I SAW THIS ONE IN A NEW LIGHT



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get all three books

HOW'S IT GOING, DARLING?

FAST! I'M INTO HYDRAULICS ALREADY. AND I THOUGHT I WAS TOO OLD TO LEARN

5 SIGNING UP FOR THAT I C S COURSE WAS THE SMARTEST THING I EVER DID

6 ONE MONTH LATER...

GOOD TO SEE YOU BACK ON YOUR FEET, JIM. IT'LL BE AWHILE BEFORE YOU'RE BACK IN THE FIELD. SO WE'LL FIX A TEMPORARY DESK FOR YOU IN THE OFFICE WHEN YOU'RE READY

I'M READY NOW, MR. WALSH

7 THEY GAVE ME SOME SIMPLE ASSIGNMENTS... AND I SURE SURPRISED THEM!

SAY, WHERE DID YOU LEARN ABOUT PUMPS?

SAME PLACE YOU DID, JOE... I C S

8 THEN A FEW DAYS LATER, MR. WALSH CALLED ME IN...

JIM, I'M KEEPING YOU HERE AND PUTTING YOU ON SALARY. YOU'LL BE GETTING ABOUT \$20 MORE A WEEK. AND AT THE RATE YOU'RE GOING, I EXPECT I'LL HAVE TO RAISE THAT IN SIX MONTHS

9 THAT EVENING, JANE AND I WENT HOUSE HUNTING

OH, JIM! IT'S A DREAM HOUSE!

AND THANKS TO I C S IT'S A "DREAM" THAT CAN COME TRUE!

MODEL HOUSE

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A cure for the common cold has been with us for years, according to Stanford University chemist Linus Pauling. Heavy doses of vitamin C, he claims, will prevent many colds or decrease the intensity of the symptoms. "The people of the United States spend about \$500 million per year on cold medicines," says Prof. Pauling. "These medicines do not prevent colds. They may decrease somewhat the misery of a cold, but they also do harm because of their toxicity and side effects." Vitamin C—ascorbic acid—is a natural food with extremely low toxicity. Though it has been commercially available for decades, it usually is taken only in amounts too small to do any good, Pauling declares, a practice that he attributes in part to the average physician's ignorance of nutrition. The chemist, who won a Nobel prize in 1954, cites scientific studies and his own experience in backing up his contention.

Seventeen amino acids have been found in a meteorite that fell on Australia last year. This report comes from a team of American scientists—Dr. Cyril Ponnampertuma of NASA's Ames Research Center, Dr. Ian R. Kaplan of UCLA and Dr. Carleton Moore of Arizona State University—who say the crystalline structures of many of the acids show them to be forms rarely found on Earth. This is regarded as the strongest evidence yet obtained that conditions suitable for the evolution of life exist in space. Amino acids compose the proteins needed for maintaining life.

Feet and inches are getting competition from meters and centimeters at NASA. From now on, certain of NASA's technical publications will use metric units to express measurements, making the space administration the first federal agency to take this sensible step. Since it uses decimals and multiples of 10, the metric system is far simpler than the English system (feet, inches) that we inherited centuries ago. It may not be long before the United States will be the only industrial nation to continue to use the English system. Even Great Britain, a long-time holdout, is switching to metric units.

Common table sugar is a "wonder drug" for cut roses, prolonging their vase life for as long as 10 days. Researchers at Cornell University mix sugar with distilled water that has been treated with a germ killer. The sugar is a vital source of plant food, say the scientists, and the germ killer keeps the water-conducting system in the plant from being plugged by microbial infections. Ordinarily, cut roses last about six days.

A throw-away clinical thermometer, costing but a few cents, has been developed by a New Jersey research firm. The instrument consists of a strip of aluminum with a series of chemical dots fixed to it. The strip and dots are encased in plastic to permit the thermometer to be used in the customary way, under the tongue. The dots react to heat, turning from white to blue to indicate specific temperatures. Reaction time is in seconds compared to the several minutes required by a glass thermometer. The throw-away feature eliminates the possibility of cross-infection caused by a "dirty" thermometer.

Air pollution has doubled over the North Atlantic since the early 1900s while the cleanliness of the South Pacific atmosphere has not changed. This finding was made by scientists of the National Oceanic and Atmospheric Agency who compared data on the electrical conductivity of the early-century atmosphere—gathered on Carnegie Institution expeditions—with similar information obtained during a recent global research cruise. Conductivity is related to amounts of particulate matter in air. The vast ocean regions and limited land masses of the southern hemisphere, say the scientists, have not seen the enormous increase of sources of manmade pollution experienced by the northern hemisphere. ★★★

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Residence Schools / Camps Directory

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Wentworth Military Academy

Preparation for the rigors of business or higher education. Accred. 4-yr. U.S., separate 2-yr. College Sr. ROTC. New million-dollar field house, Golf course, Pool, FAA flying. Summer school; younger boys' camp. 91st year. Catalog. Col. L. B. Wikoff, 911 Washington Place, Lexington, Mo. 64067

As a service to our readers and their families, we are now including this Schools/Camps Directory, offering listings of the finest schools—college preparatory, technical schools and military academies—we hope their services will be beneficial to the success of today's youngsters so that they might be the strong foundations of tomorrow's world.

Missouri Military Academy

AND SEPARATE JR. SCHOOL

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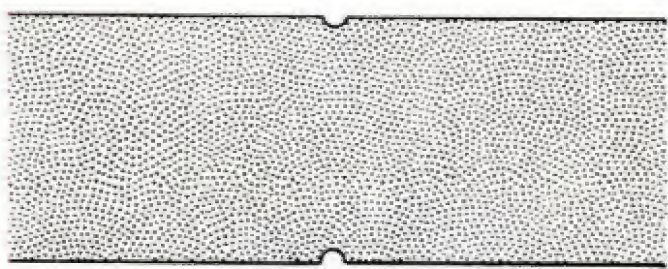
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Drivin' with Dan

What's the best procedure for approaching a hairpin turn? What is c.i.d. and how is it measured? Will changing wheel size affect speedometer reading? Dan Gurney answers these and other automotive questions

Q. Isn't it correct procedure, when you approach a hairpin turn (unless it's banked) to let off the gas and downshift when coming in, then shift back into high when going out of the turn? My brother says I'm wrong. What do you say?—Bill Ohl, Albany, N.Y.

A. You are correct, basically. Depending on the gearbox and the gear ratios, you might go all the way down to first gear and then back up through second, third, fourth and so forth upon leaving the turn.

Q. What does "destroyed" mean?—Ken Lewis, Richvale, Calif.

A. Stroking a crankshaft means regrinding the throw off center to lengthen the stroke of the piston. Destroying means regrinding to shorten the stroke.

Q. I've heard that you have won in every category of racing. What about drag racing?—John Virge, Plymouth, Mich.

A. I have not won in every category of racing. I did, however, drag race in earlier days and I even beat a few cars. You surely can't

win them all. I've managed to win in sports cars, G.T. cars, production cars, stock cars, Indy cars and G.P. cars. I've led a few oval races, but never won one. I've never raced on dirt, though I love to watch dirt racing.

Q. Since Swede Savage is replacing you in the racing scene, will he also drive the Can-Am circuit, along with the other circuits that you participated in?—Johnny Hahn, Indianapolis.

A. He'll drive in everything that we (All American Racers) participate in. 1971 should be an exclusive USAC Indy-car racing season for the A.A.R. Bobby Unser will also be driving for us.

Q. A friend recently said that because of WW II gasoline shortage, many people ran their cars on a gas which he believed to be methane (swamp gas). Is this true? Could an internal combustion engine be made to run on gas?—Mark Eghers, Cincinnati.

A. Yes, this has been done. Now propane conversions are becoming popular. Propane is an economical, efficient and clean fuel for internal combustion engines. See *Propane Power! Should You Switch to LP-Gas?*, page 85, Oct. '70 PM.

Q. Could you explain what c.i.d. displacement is? I'm curious as to how it is measured or determined.—Rudy Zweetzig, Franklin Park, Ill.

A. C.i.d. stands for cubic-inch displacement. You can determine this mathematically by applying the formula for measuring the volume of a container. In this case, it's the volume of the space within the cylinder walls between the points reached by the top of the pistons at their highest and lowest points of travel (stroke). Try to visualize the shape

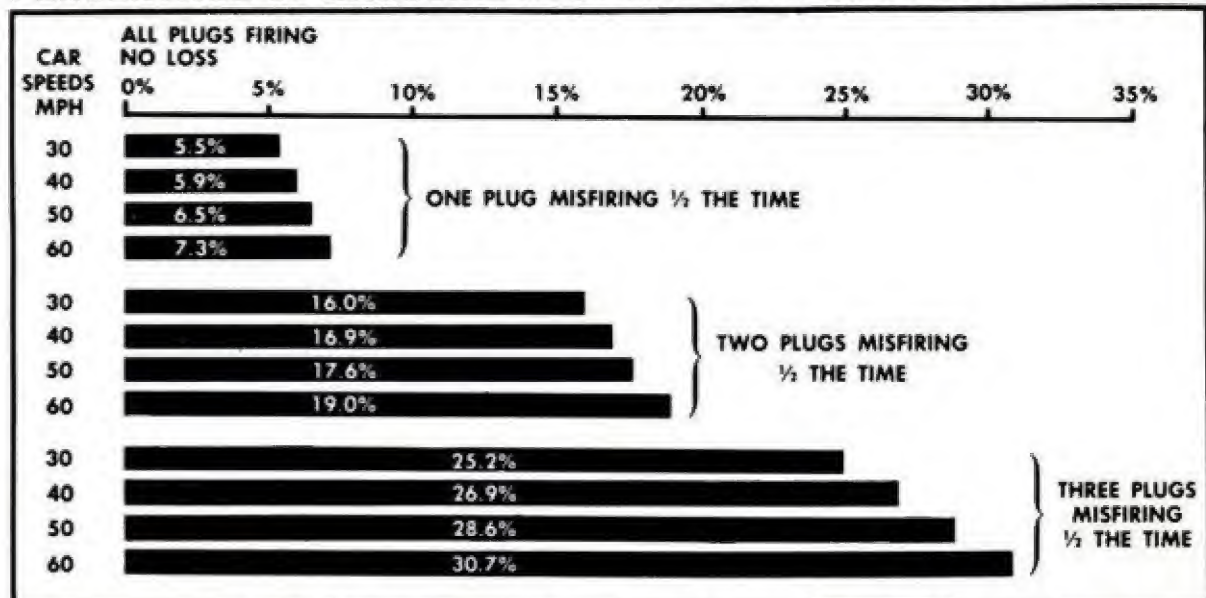
(Please turn to page 28)

SWEDE SAVAGE in the Gurney Eagle scored his first USAC championship victory at Phoenix at 116 mph. Win was Dan's first as All American Racers team manager



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DRIVIN' WITH DAN

(Continued from page 26)

of the "container" scribed by the piston as it makes one complete stroke.

So, figure the area of the circle (bore of the cylinder) by multiplying 3.1416 by the square of its radius (πR^2), then multiply this total by the stroke to get volume of the cylinder. Multiply this volume by the number of cylinders to get the c.i.d.

Q. Why did your Trans-Am Cuda have a front spoiler? To qualify a device like that, I thought it had to be homologated into 2500 street Cudas, and I don't know of any street Cudas with spoilers.—Thomas Kee, Ellendale, N.D.

A. Yes, it did. Apparently the rules allowed it. It helped, also.

Q. If a car originally had 14-inch wheels and you changed them to 15-inch, how would this affect the speedometer reading, if at all?—Randy James, Macomb, Ill.

A. It depends entirely on the circumference of the tire. When a tire makes one revolution, it covers so much distance. If the tires had the same circumference, the wheel size wouldn't affect the speedometer reading.

Q. I would like to be a race driver and wonder how you got started in racing.—Bill Glass, Lancaster, Pa.

A. I began racing with a Triumph TR-2 sports car in amateur road-racing with the California Sports Car Club in 1955 at Torrey Pines, Calif. Before that I was hooked on hot rods.

Q. Is the 289 Ford engine just as good as the 302? I say it is, but my friends disagree.—David Householder, Ellwood City, Pa.

A. What do you mean by good? They are both good. The 289 is, possibly, a bit smoother and should get a little better mileage. It's a bit lighter. The 302 is newer and slightly more powerful.

Q. Can foreign nationals, as from India, enter Grand Prix races? If so, is there an age limit?—S.K. Malmotra, Gandigarh, India.

A. You must be 21 years old and be able
(Please turn to page 30)

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DRIVIN' WITH DAN

(Continued from page 28)

to qualify for the race by going fast enough in practice. Often there are more cars trying than there are positions open and then it gets tough. Each G.P. organizer has his own rules on eligibility and entry fee.

Q. What was the purpose of the orange light in the rear side window of your AAR Cuda which I saw in the Trans-Am last year?—Joseph Hibbard, Jr., West Chester, Pa.

A. The light was on when the reserve gasoline supply was being used. We knew the car would soon have to pit, or else the driver could be signaled to shut off his auxiliary pump if it was still turned on right after a fuel stop.

Q. My friends and I often argue about Ford and GM cars. I say GM cars rust out and they say that Fords fall apart. Which would you rather have?—Ricky Braun, New Orleans, La.

A. They are both very good. I'd say it boils down to old loyalties (or new ones) and personal relationships with dealers. I am neutral. If you take care of your car properly, it won't rust or fall apart for a long time, no matter what make it is.

Q. In your opinion will the turbine engines ever replace the reciprocating engines in passenger cars?—E.H.M., Wilmington, N. C.

A. In my opinion, not for 8 or 10 years. Then a replacement may be something besides a turbine. A turbine works best at a constant speed. It is really good at high altitude in an airplane, but it's not so good idling around town.

Q. I know all about Bobby Unser and "his mountain." Would you ever drive Pikes Peak?—Paula Haine, Indianapolis, Ind.

A. Yes. I have often considered the possibility of giving it a try. Maybe some day I will—not in competition, however. ★★

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 58).

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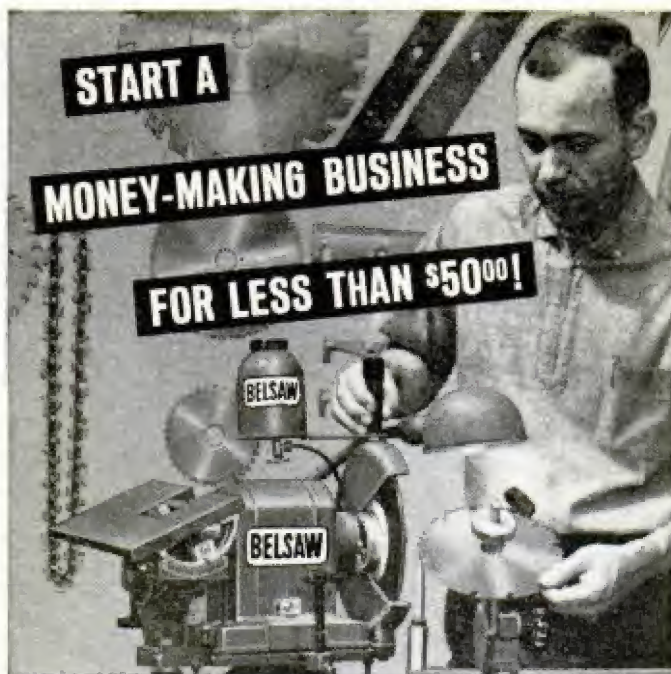
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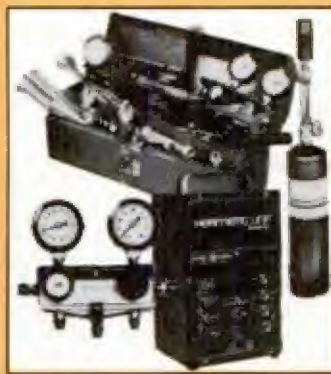
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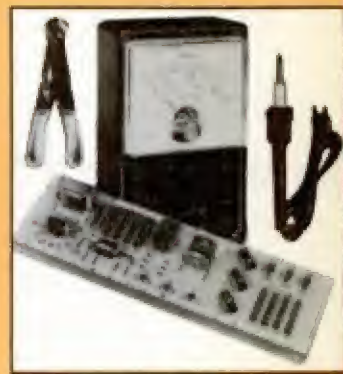
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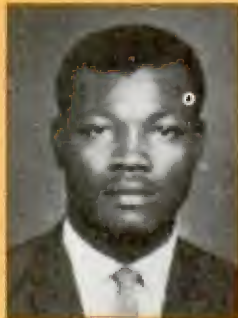
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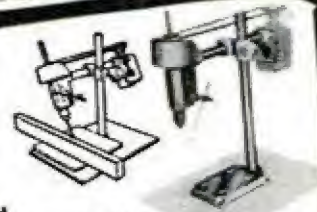


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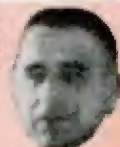
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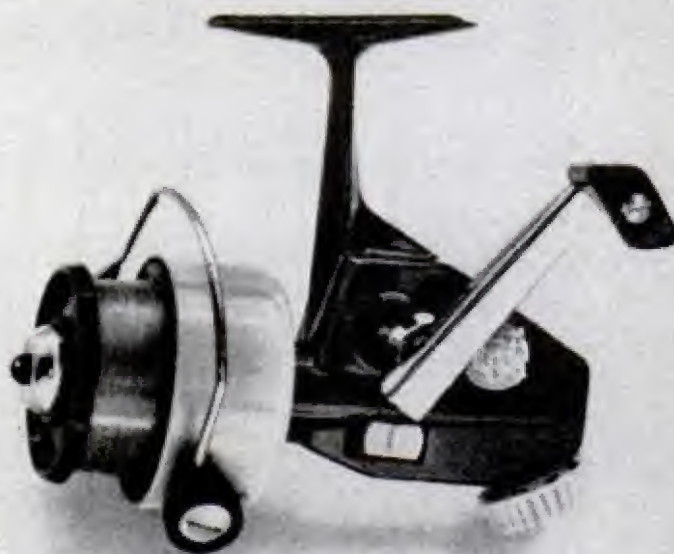
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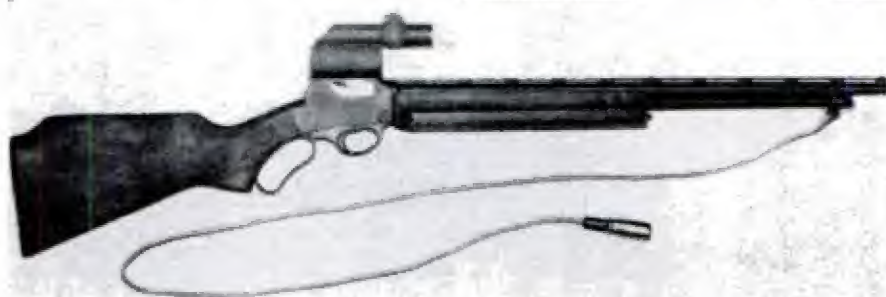
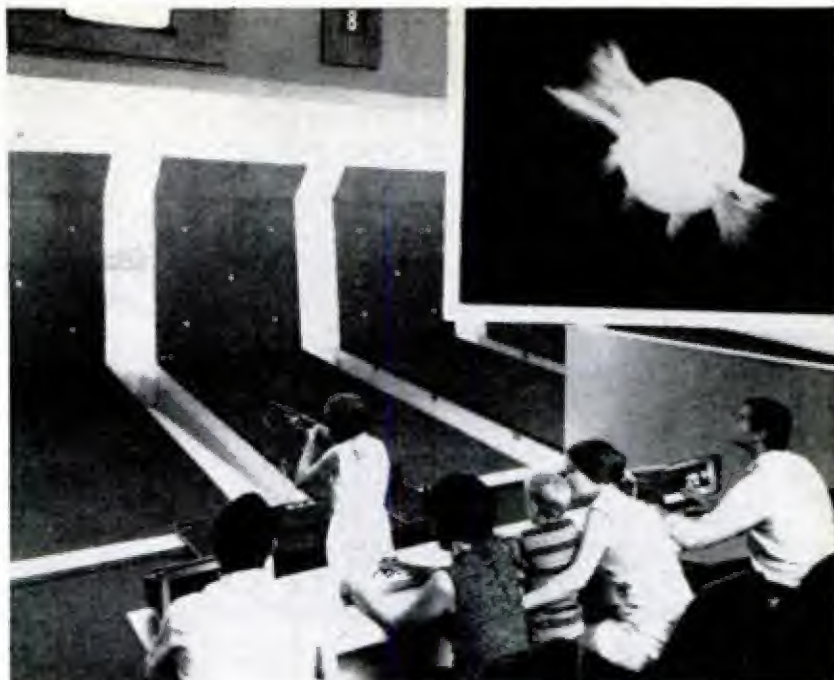
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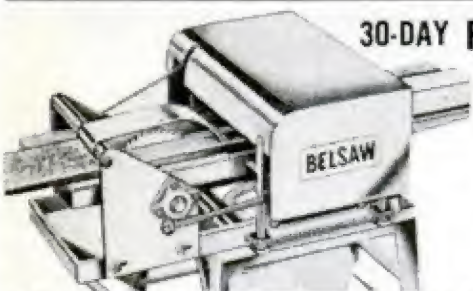
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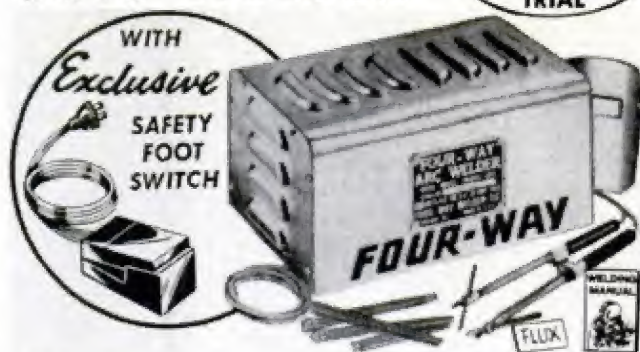
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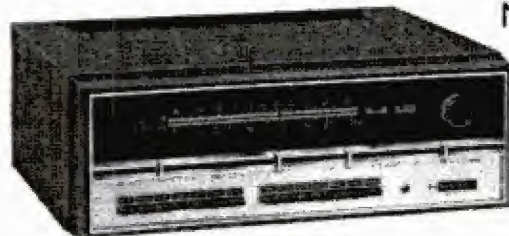


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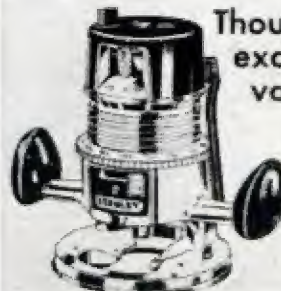
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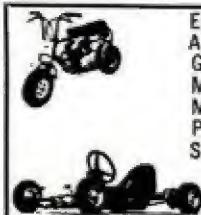
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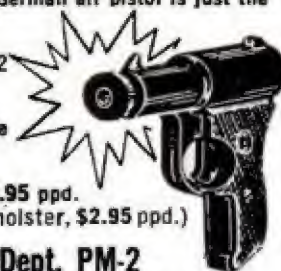
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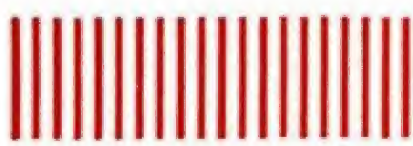
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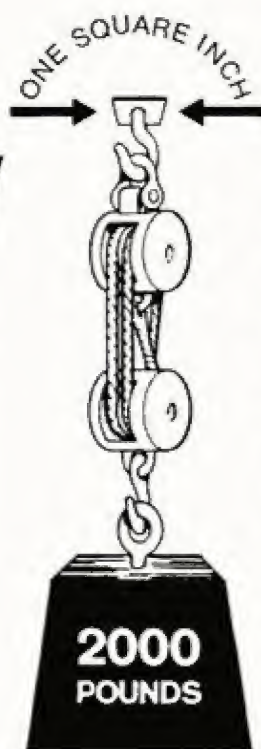
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Supports 200 lbs. in 5 minutes...
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PUBLICATIONS **WORTH WRITING FOR**

BY CATHERINE BILSKI

EVERYTHING a do-it-yourselfer needs to know about selection, carpentry and installation of prefinished wood moldings is contained in a new information folder entitled *How to With Prefinished Wood Mouldings*. Illustrated with both close-up detail sketches and comprehensive room scenes, it contains profiles of all the most popular prefinished molding patterns and includes the basic steps in paneling installation. It's available for 10 cents from Western Wood Moulding & Millwork Producers, P.O. Box 25278, Portland, Ore. 97225.

TOYS PLAY AN IMPORTANT ROLE in your child's life, and toys wisely chosen can help develop his abilities. The booklet entitled *Choosing Toys for Children of All Ages* clearly describes and illustrates the four main kinds of play and what toys are of interest to babies and children up

to 12 years of age. There's also a guide for selecting toys and a little chart to help you remember what you've given your favorite children. It's free by written request to the Toy Manufacturers of America, Inc., 200 Fifth Ave., New York, N.Y. 10010.

FIBERS, FABRICS, TIRES and adhesives are the subjects of the first three of a series of consumer information booklets to help the consumer make better-informed purchases in the market place. The first, *Fibers and Fabrics* (65 cents) provides information for selection and care of fabrics and apparel. The second, *Tires, Their Selection and Care* (65 cents) provides information needed to obtain maximum safety, wear and performance of tires. The third, *Adhesives for Everyday Use* (40 cents) describes the adhesives now available and lists their major uses. The three booklets can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402.

SEND FOR *Popular Mechanics'* new 32-page catalog crammed full of fascinating and useful projects you can build yourself. Send 25 cents to *Popular Mechanics*, 224 W. 57 St., New York, N.Y. 10019.

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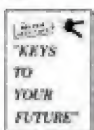
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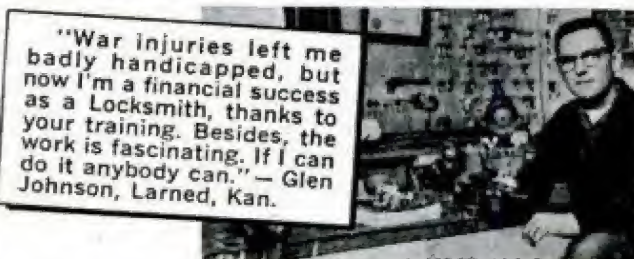
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DETROIT LISTENING POST

BY ROBERT LUND

ANY BIG MONEY THE AUTO COMPANIES SPEND on changes on the '72 cars will go into meat and potatoes, rather than cake frosting. Emphasis will be on engineering improvements, making parts more durable and safety devices. Detroit has really slammed the lid on spending for non-necessities on the next crop of cars. From a what's-visible-to-the-eye standpoint, the '72s won't be much changed.

IS GM'S INTEREST IN THE WANKEL (reported first in DLP, page 22, Nov. '70 PM) an admission the company has abandoned hope of cleaning up the reciprocating internal combustion engine? "Not on your life!" a source in GM engineering snaps back. GM believes the piston engine will remain the main source of power for American-made cars for the foreseeable future—until 1980—and that by the second half of this decade, it will meet any antipollution standard that can be written for it.


WHAT'S FORD GOING TO DO with all the money it will save as a result of its withdrawal from racing? The company isn't saying how much it spent, but you can pick a number between \$2 and \$12 million a year. The reason it got into racing in the first place—after all automakers signed a pledge not to—was to shove it down the throats of detractors who said Ford products were all right for getting to the drive-in movie or hauling groceries, but they didn't really have it in get-up-and-go engineering durability. Ford answered by letting fly with everything it had. The company made its point long ago: Ford cars can hold their own against the best machines both U.S. and foreign. It isn't about to let the competition or public forget that, despite its racing pull-out. So a portion of the money Dearborn will save by canceling its racing program will go into developing highly styled, innovative, one-of-a-kind cars for display at leading auto shows. If the showpieces or features of the vehicles attract enough attention, they'll be put on production cars.

CAR SIZE ISN'T THE ONLY THING Detroit's whittling down these days. The auto firms are also reducing the number of models in their catalogs. All of 'em cut back on the number this year vs. last. The retrenchment isn't over yet. Chrysler's already decided to drop one of its slow-sellers at mid-year.

TWO-WHEEL ANTISKID braking system—the first planned as an option for light duty trucks and large wagons—is shown being tested by International-Harvester on its Travelall wagon. The rooftop generator powers test instruments during straight-line "panic stop" tests on the low friction surface. The system, essentially the Bendix unit

available on some high-priced passenger cars, uses a small computer to control brake-line pressures. Sensors and pressure modulators on the rear wheels prevent the wheel lockups that cause skids. The system operates independently of the driver's control for as long as the pedal is depressed. The Adaptive Braking System, as In-
(Please turn to page 48)





Pigskin?
Or calf's hide?
One thing for sure...
for them it won't be an
imitation.
Their cigarette? Viceroy.
They won't settle for less.
It's a matter of taste.



Viceroy gives you all the taste, all the time.

DETROIT LISTENING POST

(Continued from page 46H)

ternational calls it, applies automatic judgment and exact timing, preventing wheel lockup that ordinarily occurs when the driver jams the brake pedal to the floor. The system will become available in late 1971 as an optional extra on International's light pickup trucks and Travel-all wagons.

GM HAS REPORTEDLY EQUIPPED test cars with bumpers, doors and other exterior panels made of a highly resilient material that resumes its original shape after minor impact. The material is apparently the same as that in the "Endura" bumper used by Pontiac. The Pontiac bumper returns to its original shape after a collision (providing you don't smack it too hard), won't chip, rust or pit from stones flying up from the road. The process is probably practical for exposed sheet metal, other than bumpers, but it's costly and is not too likely to make its appearance on any production cars in the near future.

SPEAKING OF NO-DENT BUMPERS, the insurance companies say they will reduce rates when producers bring out cars able to withstand a five-mile-an-hour front or rear collision without crinkling the bumper. Four leading insurers have said they'll cut premiums 20 percent when Detroit meets this requirement. The no-dent bumper is coming. It will be on most '73 cars. But the auto companies are betting beefed-up bumpers won't reduce insurance premiums for two reasons: (1) inflation in what it costs to have a car repaired and, (2) because there's a shortage of body and paint shops and manpower to operate them. The only way to attract manpower, Detroit seers say, is to increase wages. You can't increase wages if the insurance companies reduce premiums and pay less to have cars repaired. It's an oil-and-water situation. Detroit believes the insurance industry will see the light as cars become more crashproof and back down from the promise to cut premiums.

FRONT-WHEEL DRIVE has never lived up to GM's expectations at the counter where the customers pay. Olds had it first, in 1965, and instead of 60,000 Toronados the division expected to sell, the count was an anemic 17,000. Cadillac took the item on at the start of the '67 model run and pushed out just under 20,000 front-wheel Eldorados. The count for '70 models was 25,500 Toronados and 24,000

Eldorados—small numbers by GM standards. As a result, there's always a rumor that GM will abandon front-wheel drive. Don't believe it. GM engineering remains high on fwd, so much so that the company is now looking over an idea for a one-seat, two-person car being worked up for 1974-75.

WHAT DO YOU EXPECT TO SPEND for your next new car? Two thousand dollars, \$2500, something over \$3000? If your answer is in the \$2500 range, you're figuring low. This year and next may be the last time ever you'll be able to buy any car now on the market for less than \$2500.

Starting clean, without a trade, there's no such animal as a \$2000 American-made car. There are a couple that "list" for less than \$2000. But try to buy one. There's a two-seat Gremlin at \$1899 and Pinto at \$1919. But by the time you tack on the mandatory extras—taxes, freight, dealer makeready and license plates—there's no Detroit product you can drive home for \$2000. Add on a couple of the common comforts, such as a radio and automatic transmission, and there are very few cars you can buy for less than \$2500—maybe six or seven out of the 335 different models offered by domestic automakers. And the \$2500 car is fast going the way of the \$2000 car.

The reason the \$2500 car can't survive in its present form is because of all the new gear coming out over the next few years. Take just the major items, safety and antipollution devices the government wants installed as standard equipment on everything that comes off the line. The list includes shockproof bumpers, air bags, catalytic converters (with or without electronic fuel injection) and a roadside warning light for use when cars are disabled. Uncle would also like the automakers to put antiskid systems on all cars, but that hasn't been put in the form of a decree—yet. The package comes close to \$1000. And that's without allowing a cent for inflation and higher labor costs.

The \$2500 car won't disappear entirely. Detroit will still make a few machines to sell at that price. But they won't be the same size, nor will they carry the same appointments as the \$2500 car of today. They'll be scaled-down, stripped-down vehicles that will make the current minis look like the gunboat Packards, Cadillacs and Lincolns of 20 years ago by comparison. If you want the same amount of car you're driving today come 1974, you'll find the starting price will be something over \$3000. ★★★

How can a pickup work like a truck, ride like a car?

Consider these facts:

Ford pickups give you better ideas. And better ideas are what make a Ford a better buy. For example:

Biggest cab of any pickup. Combined headroom, legroom, shoulder room and seat height dimensions exceed those of any other pickup cab.

Only Ford has Twin-I-Beam independent front suspension. Wheels step over bumps independently to smooth the ride.



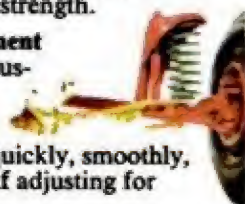
Levellest, quietest ride of them all. Virtually no nosedive on braking, less side-sway on curves. Independent tests proved Ford is quieter than all other leading pickup makes.

Most luxurious. Choose from four levels of luxury . . . all the way up to the unique Ford Ranger XLT, most luxurious pickup ever built. Distinctive good taste marks the XLT: wood-tone accents, thick-pile carpeting, deep-cushioned seats upholstered in pleated cloth and vinyl, plus luxury options like AM/FM stereo and air conditioning.



I-beam front axles. A Ford exclusive. Both axles are drop-forged I-beam design. Everybody's *big* trucks use I-beam front axle design for greater strength.

Radius rods help hold alignment better than any other front suspension system. Only Ford pickups offer radius rods.



Self-energizing brakes stop quickly, smoothly, with little pedal pressure. Self adjusting for lower service costs.

Welded, instead of bolted, pickup box stays strong, resists working loose, means greater quietness, less chance of rust.

Leaf-type rear springs, like all big trucks use, for better stability. Exclusive Flex-O-Matic rear suspension, standard on F-250 and with heavy-duty springs on F-100, keeps the ride smooth, with or without a load.



Make sure your next pickup includes the better ideas you get only from Ford. See your Ford Dealer for the pickup that works like a truck, rides like a car.



A better idea for safety: Buckle up.

FORD PICKUPS



NEW BRUNSWICK, N.J.—An automatic, forced-air multiple chamber incinerator for industrial, commercial and institutional solid waste is called Radicator by its manufacturer, Ross Engineering Corp. The design consists of a semi-cylindrical, grateless combustion chamber, an aerodynamically-inclined breeching which serves as a mixing chamber, an afterburning chamber and an automatic rear loader. The programmed operating sequence provides positive control of combustion, temperature and smoke. Smokeless and odorless, the device has passed government antipollution standards and can dispose of 600 pounds of solid waste per hour.

SACRAMENTO, CALIF.—"Smog sniffers," devices for making roadside measurements of hydrocarbon emissions from automobiles, are being used by California highway patrolmen. Developed by Autoscan, Inc., of Los Angeles, the analyzer is about the size of a portable TV and, if approved for general use, could be employed by smog inspection stations set up at service stations or repair garages.

TAMPA, FLA.—The possibility of using warm water for aquaculture, or sea farming, is being investigated by the Tampa Electric Co. as part of a broad ecological study. Experiments will be conducted to produce new yields of oysters, clams, shrimp and other food in an artificially heated seabed. If a new industry can be developed, the problem of food for our growing population may be eased.

HAUPPAUGE, N.Y.—The first law banning the sale or distribution of detergents was passed here recently and will go into effect March 1. Although it is aimed at two foaming, dirt-loosening agents, alkyl-benzene sulfonate and alcohol sulfate, it does not ban phosphates. The purpose of the law is to reduce the amount of the substances entering Suffolk County's groundwater, causing cloudy and bad-tasting tap water.

SALT LAKE CITY—A junk-car "shredder" is under construction by Pepper Allied Metals and Learner Co. of Oakland, Calif. to provide a pollution-free, economical means of disposing of the growing number of old hulks. Whole or compressed cars are shredded by "teeth" powered by a 1500-hp motor. Iron and steel fragments are recovered by an electromagnet while nonferrous metals and combustibles are burned off in a closed furnace. All residue of the burning is contained in a bath of water.

DO YOU KNOW about some action being taken to fight pollution that we don't know about? In your community? On the job? Tell us about it. Write Environment Editor, Popular Mechanics, 224 W. 57th St., New York, N.Y. 10019.

✓ *Ted Williams*
QUALITY

When you see this brand name, you know the equipment has been tested and approved by a Sears Sports Advisory Staff member. Ted Williams, Chairman, tested this rod personally. You know you can count on it for quality, value and performance.

Your rod's probably made with fiber glass cloth. The criss-cross fibers work against each other and break.

It's a different story with a Ted Williams rod. Thousands of glass fibers run the length of it. That's why you can shake Ted's rod by the tip without breaking it.

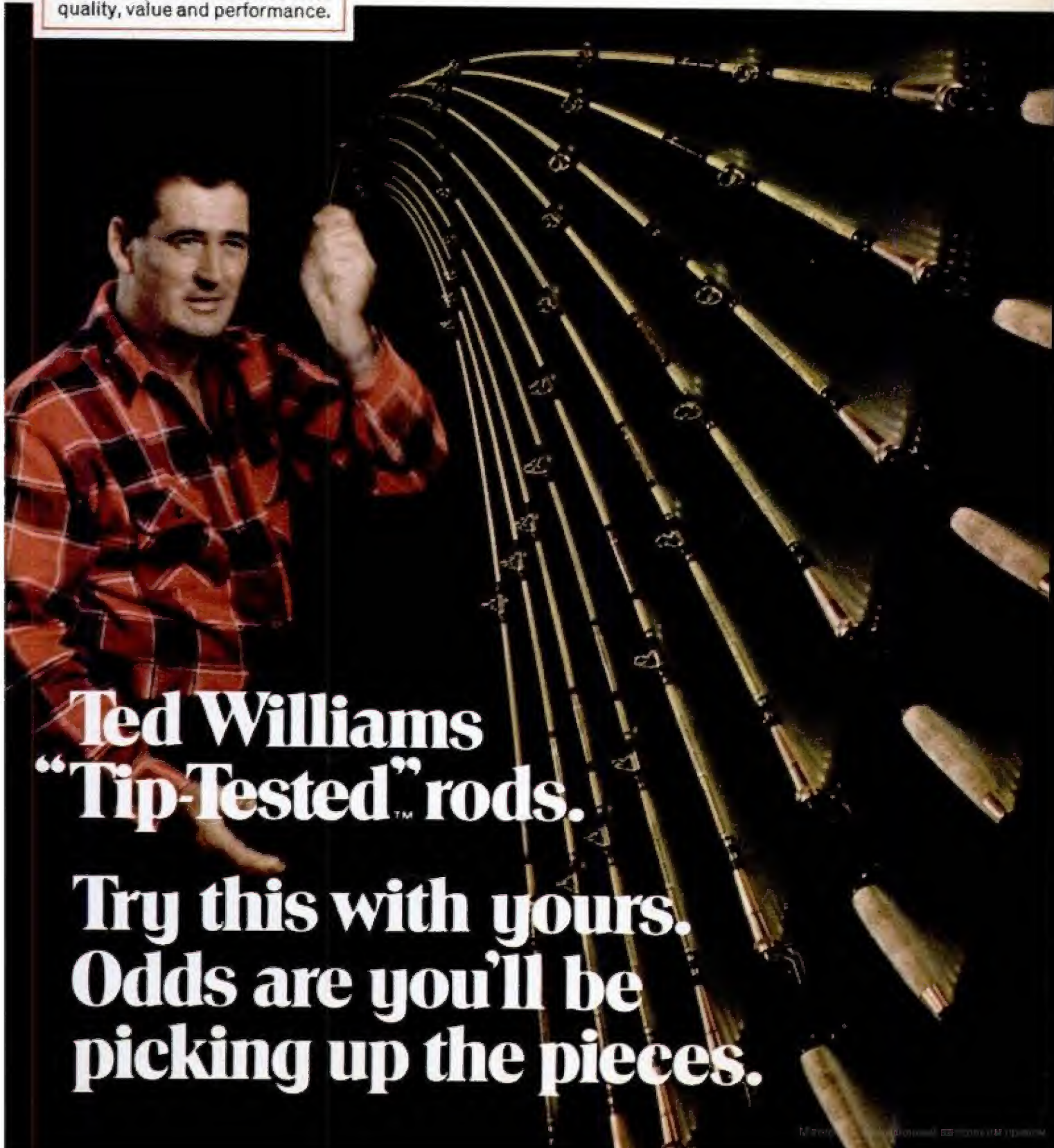
But it's when you hook a lunker you really feel the difference—the power, the uniform action of the rod from tip to butt.

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ON-THE-GO

CAMPING

BY V. LEE OERTLE

COACHMAKER PROVIDES FREE CAMPING TRIPS. Boise-Cascade, parent company for several recreational vehicles and owner of thousands of acres of forest, is now handing its buyers a recreation guide that tells them how to reach its free private forest lands. Another manufacturer has predicted the day will come when campers must prove access to outdoor facilities before they can enter a recreational region. This move by Boise-Cascade may be the first step in that direction. It means that coachmakers must assume a broader responsibility for the products they sell and how they are used.

WITHIN THREE YEARS, ALL TENT TRAILERS WILL HAVE HARD TOPS. That's the surprising trend indicated by tent-top makers. Though many buyers select a tent-trailer because of lightweight features, research reveals that the primary motivation is the fold-down design which allows low-silhouette towing. Reasons cited for switching to all-hardtop trailers included freedom from maintenance, improved security for campers and their cargo (in lockable compartments), more protection from weather, ease of heating interior with hard top and hard walls, and increased longevity.

NEW 1971 FORD PICKUP IN 1-TON RATING WITH 9-FOOT BOX. That's right, the new Ford model looks almost identical to the popular $\frac{3}{4}$ -ton Camper Special—but on a larger scale. This move will permit greater flexibility now in new designs for slide-in camper coaches weighing up to 3500 pounds or more. For those buyers who like the freedom inherent in slide-in models, yet need more space and more interior facilities, the new 1-ton series may be the answer. (See "Pickups That Pamper," page 98).

LESS DEMAND FOR HOOKUPS IN CAMPGROUNDS? Many private campground operators claim that up to 90 percent of their customers seldom demand sewer, water and electricity. Given a choice at less cost, virtually all travelers this past season selected the standard nonself-contained sites. Most campers prefer an electrical hookup over water and sewer. Reason: water tanks can be filled every few days from a central supply source and holding tanks can be emptied for a modest charge about once weekly, but electric power is required to operate such appliances as airconditioners and refrigerators and, in some models, heaters.

NEW ATV IN KIT FORM FOR UNDER \$700. They call it the Gnat. Dimensions when completed are 75 inches long and 47 inches wide, with weight about 245 pounds. The new High-Flex tires from B.F. Goodrich are utilized. The maker claims the ATV speeds up to 40 mph on flat terrain. A key-operated ignition system, chromed bumpers, fold-back headlights and heavy upholstery and padding are said to make the Gnat unusually comfortable. It's being marketed by American Pride of Troy, Mich.

CHEAP MATTRESSES PLAGUE SOME RVS. Few buyers pay enough attention to the fact that mattresses range in thickness from 2 inches for bunk pads to 5 inches in deluxe units, while length varies from 74 to 90 inches. So measure before you buy. A 6-foot body cannot rest comfortably on a 6-foot mattress, as many have learned too late.

CROSS-COUNTRY CAMPGROUND DEVELOPMENTS will boom faster than ever. Unless our predictions are all wrong at least a score of large motel, hotel and restaurant chains will build campgrounds at a fantastic rate during the next 36 months. As one motelman told me privately, "Your readers haven't seen anything yet! Our own company is talking about 400 new overnight parks within the first two years. If they do well, the sky's the limit." Another chain already operating, Red Arrow Industries, Inc., now has campgrounds in 30 states. Within five years, the number of private campgrounds could very well double from the present 7000 or so. ★ ★ ★

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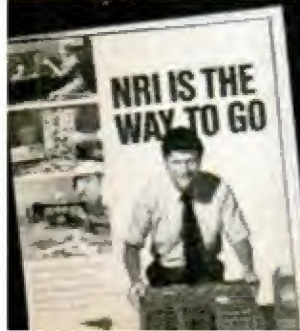
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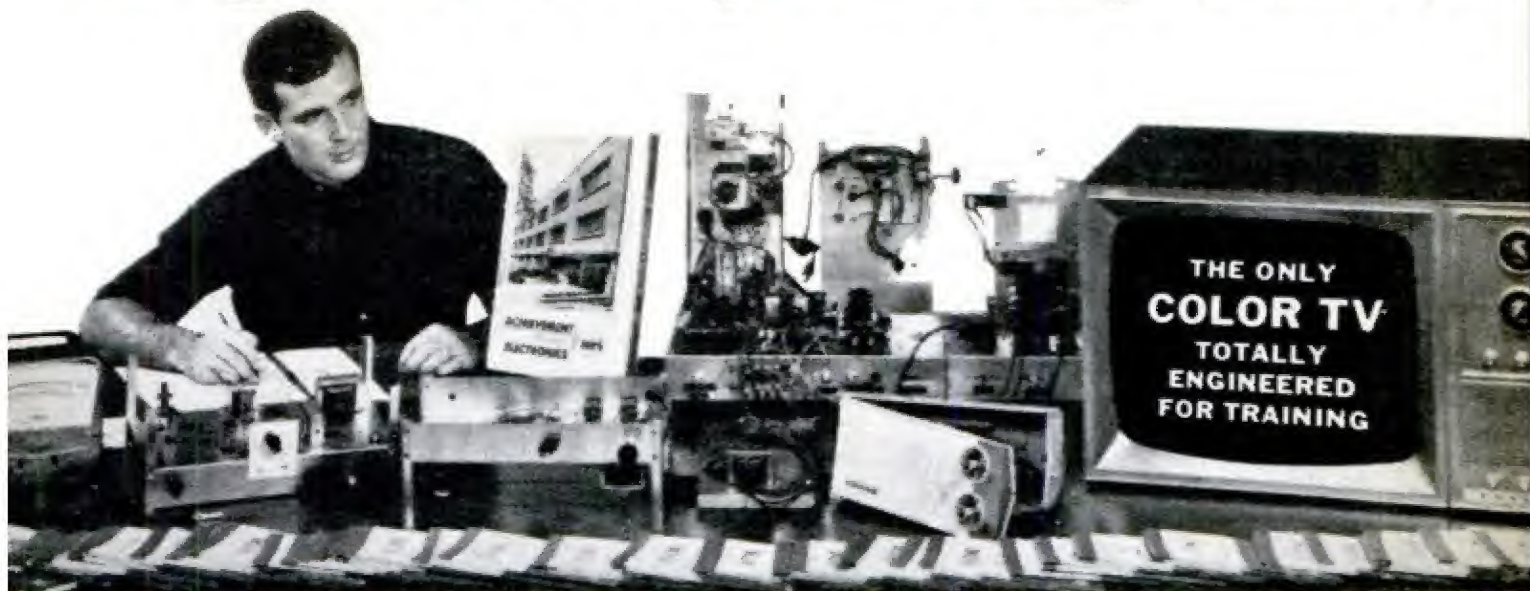
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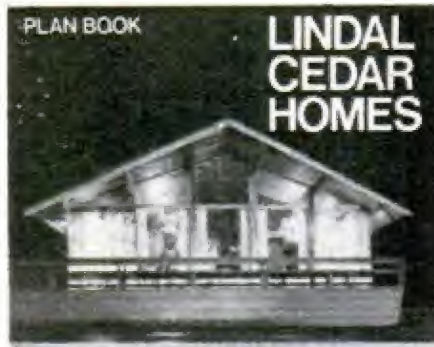
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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Wrong battery water

I was shocked the other day to see a service station attendant fill my battery with water from a tap. He explained that it is no longer necessary to use distilled water—that battery manufacturers are using new plates or something. Am I wrong in believing that only distilled water or rainwater caught in a plastic container should be used in a battery?—R. E. Volkert, Dubuque, Iowa.

You are absolutely right. The composition of today's battery plates is the same as it has been for years. Iron in tap water will cause plates to accumulate iron oxide, which will shorten the battery's life. I suggest that car owners check batteries themselves to insure that only distilled water or rainwater is used. The payoff will be maximum battery life.

Strange tire wear

The outside of the right rear tire of my 1969 Chevrolet Malibu wears bald every 7000 miles. The other three tires show no wear. How come?—Spec. 4 D. E. Hayes, APO San Francisco.

Probably because of a bent rear differential housing. See a Chevy dealer when you get home. It isn't news to him.

Dwell awhile

In checking the dwell on my 1968 Dodge Coronet (273-cu.-in. V8 engine), I found a variation of 6° from idle to 1500 rpm. At idle, dwell is 34° and moves to 28° at 1500 rpm. The manual says that a 2° difference indicates a problem, but the dealer tells me my dwell is only off by 1°. He contends that the dwell-angle setting can be anywhere from 28° to 33°, which is the specification spelled out in the manual. However, I always believed that dwell should remain pretty much constant throughout engine operation—for example, that if you got a reading of 29° at idle (or 30°, 31°, and so forth) it should remain about the same at any rpm. Am I wrong?—M. A. LaRocca, Pittsburgh.

No, the dealer is wrong. You are getting a variation of 6°, which is too much. The first thing I would check is the vacuum

advance. If it's okay, then there is wear inside the distributor (cam, shaft).

A squealer

When more than two people ride in my 1969 Ford LTD a high-pitched squeal that resembles a distant whistle or siren is created. My mechanic is at a loss to explain this strange occurrence. Please help.—L. J. Cassidy, Providence, R. I.

An altering of the car's weight may cause a shift in position of a dry transmission extension seal. I suggest lubrication.

Try a new mechanic

I have a problem with a 1967 Pontiac Firebird (OHC-6). It backfires, pings, has a rough idle, and the plugs foul in two cylinders. The car has been to the shop for carburetor adjustments and tune-ups six times in the last year. Now they tell me they can't adjust the carburetor correctly because the PVC unit on '67 and '68 models interferes with it.—Virginia Holland, Fresno, Calif.

Baloney. Tell them they ought to try another trade, and then go find yourself a mechanic who knows what he's doing. For example, one of the first things that should be investigated is the possibility of leaking or sticking valves in those two cylinders which foul.

VW service manual

Can you tell me how to get a service manual for a 1969 Karman Ghia, which was promised to me by the salesman when I bought the car? He now tells me they are hard to get, but several VW owners I know have them.—Harold E. Brown, Woburn, Mass.

This manual should be available through the dealer, but if he is having trouble I suggest you write the director of publications, Volkswagen of America, Englewood Cliffs, N. J. 07632.

To fix a Fiat brake

I have a 1969 Fiat 124 Sports Coupe which has disc brakes. They squeak as
(Please turn to page 60)

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AUTOMOBILE CLINIC

(Continued from page 58)

loudly as rusted door hinges. The dealer told me before I was shipped overseas that this is an inherent problem. Is he right?—Sgt. James Aiello Jr., APO New York.

He was, but he isn't anymore. See him when you get home. Word has come down from Fiat to replace the front brake shoes with a new, improved type. The dealer can get the scoop on this by contacting his regional Fiat representative.

Oil-starved

To check a ticking noise in the valve train of my 1968 Buick Riviera, I pulled the valve covers and found that oil wasn't getting to the rear rocker arms. What's wrong?—John R. Rumer, Des Moines.

The rocker arms in this car are fed by drilled passages in the block and heads. These passages connect with the rocker shaft at the front shaft mounting pedestal. Oil then passes back through the rocker arm shaft. Each individual rocker arm is fed by holes that are drilled into the shaft. It's quite possible that in your case one or more of the holes have become plugged. If so, have them unplugged.

The high, hard one

The brake pedal of my 1969 Plymouth becomes high and hard on long trips. What can cause this?—George Hamman, Lawrence, Mass.

A plugged relief port in the master cylinder.

Applying heat

My 1967 Pontiac with 400-cu.-in. engine and four-barrel carburetor practically quits on me in hot weather when the air-conditioner is running. I am unable to unstick the heat-riser valve. Could this cause the problem? What's the solution?—Newman Faulkner, Garland, Tex.

If the heat riser is stuck in the closed position, which seldom happens, it could be causing the trouble. The solution is to tap the counterweight arm with a hammer to try to loosen it up, and then to lubricate each side of the shaft with

graphite or heat-riser lubricant. If this doesn't work, you'll have to replace it. However, since you indicate the trouble occurs only in hot weather, I doubt if it's caused by the stuck valve. Inability of the carburetor to vent itself because of a clogged antipercolation port seems likely.

Halfway fuel gauge

The fuel gauge in my car goes up to the full mark when the tank is filled, but won't go below the halfway mark. I've been keeping one of those magnetic-catch flashlights fastened to the dashboard and wonder if the magnet might have something to do with the problem.—A. P. Wasenaar, Gresham, Ore.

Not at all. The fuel gauge is nonmagnetic. I imagine that the problem is with the sending unit in the gas tank.

Service Tips

● All Chrysler Corp. cars and light-duty trucks for a number of years have had left-hand-thread wheel-mounting nuts and studs on the driver's side and right-hand-thread nuts and studs on the passenger's side. If you have a 1971 model, you'll want to note this has been changed. The wheels have right-hand-thread nuts and studs on both sides.

● Oldsmobile tells us that broken station-wagon tailgate hinge pins have been turning up because lubrication has been denied them. Those pins and hinges should be lubricated periodically with the tailgate in open position. If the pins have started to seize, use a penetrating oil to free them.

● Some 1970 Chevelles and El Caminos came equipped with an incorrect oil dipstick, resulting in a low level of 6/10 to 1½ quarts. The correct stick measures 19-17/32 inches from the bottom of the handle to the FULL mark and 20-11/32 inches from the bottom of the handle to the ADD mark. If yours doesn't, get the right stick (part No. 3925599).

● A tip from FoMoCo: Whenever you have to use a booster battery, turn on the heater or airconditioner blower to keep the small light bulbs in the instrument panel from being blown by the sudden surge of high voltage. Also be sure that engine speed doesn't exceed 1500 rpm when the engine has started and booster cables are disconnected. ★ ★ ★

GOT A PROBLEM WITH YOUR CAR? Ask Mort about it. Send your question to Auto Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.

less is more.

This new Johnson 50 packs more performance into less space than any mid-range outboard motor. Ever.

The usual thing is to try to make it bigger and better. Johnson engineers set out to make the new Sea-Horse 50 **SMALLER** and better — and achieved a very unusual thing indeed! Its striking silhouette is the most obvious result of this "less is more" approach, but only hints at even more dramatic interior innovations.

First of all, this two-cylinder engine is **LOOP CHARGED** —

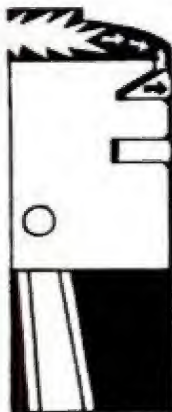
a more efficient method of recharging cylinders with a fresh mix of fuel and air, then scavenging the burnt gases from those cylinders.

Loop-charging brings fuel in and exhaust out in one continuous loop through a series of aimed ports. Our design employs lighter, cooler running, flat-topped pistons and domed combustion chambers. It's a hot idea that increases horsepower, decreases weight and fuel consumption.



Johnson's unique **PRESSURE-BACK PISTON RING*** helps to seal the combustion chamber by using compression to force the ring against the cylinder wall. Results,

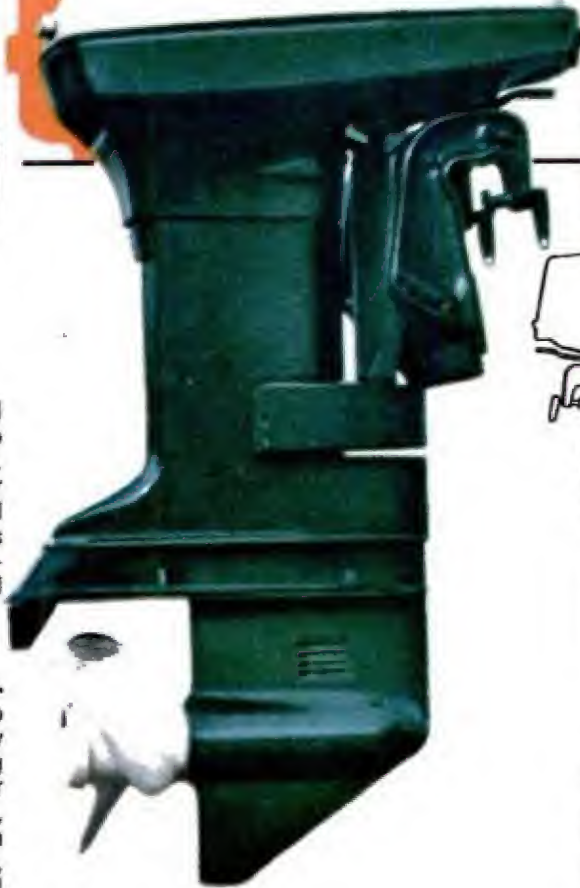
reduced friction and engine wear, improved fuel economy. There's a new fuel saving system too, which combines a pair of newly designed carburetors with "straight-in" fuel induction and no fuel trapping pockets. Another drain free motor from Johnson.



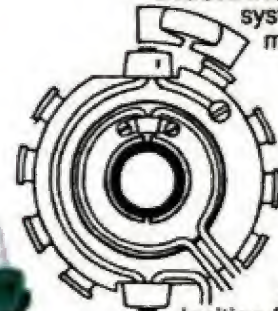
*Patent applied for.

6" lower off the transom than other 50 hp outboards

50 Johnson

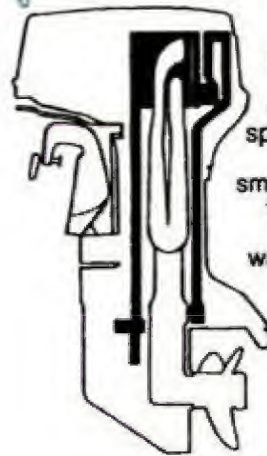


The solid state **CAPACITOR DISCHARGE IGNITION**



system is a new magnetic controlled type. There are no moving mechanical parts — no distributor, no belts, no breaker points. It will even provide ignition for the engine without the battery. The spark plugs are a new surface-gap type with tungsten alloy electrodes. They should provide up to 1,000 hours of use in this engine.

THE COOLING SYSTEM is both thermostatically controlled and (for the first time)



pressure controlled. At low speeds, the engine is kept warm for smooth running and fuel efficiency. At higher speeds, water circulation is increased. The engine runs appreciably cooler at full throttle than it does at idle, so you get more power at the high end and increased engine life.

EXHAUST-TUNING is achieved with an internal, closed end megaphone system. It results in more power on less fuel. Power shifting is standard equipment on this motor, along with our exclusive single-lever remote control which combines the key-switch, choke and throttle. Choose from eight standard or six high performance props as optional extras.

From idle to full throttle, this outboard is a new experience. No other motor — in our line or anyone else's — offers so much of tomorrow, today. Your Johnson dealer is showing it right now. Stop in soon. Or write for free catalog: Johnson Motors, Waukegan, Ill. 60085, Dept. PM-271

Johnson
First in Dependability • Division Outboard Marine Corporation

See all the new Johnsons — 2 to 125 hp.

THE ALL NEW OPEL 1900. NO OTHER ECONOMY CAR (FOREIGN OR DOMESTIC) GIVES YOU ALL THIS.

Last year, Opel offered you one wagon, the Model 39, shown at rear.

This year, Opel adds another choice. The all-new Opel 1900 wagon.

It offers many things as standard equipment that other economy cars offer as optional equipment. Or not at all.

For example, the Opel 1900 is the economy car with hydraulic valve lifters, just like the big American luxury cars, for a quiet-running engine and eliminating the need for adjustments.

The Opel 1900 has front power disc brakes for quick, smooth, straight-line stops. As standard equipment.

The Opel 1900 has lots and lots of room. The cargo area is fully carpeted and the luggage compartment is cleverly hidden. And please notice, the Opel has adjustable backs on its front bucket seats and headrests as standard equipment.

The Opel 1900 has a four-speed manual transmission as standard equipment.

And a three-speed, fully automatic transmission is available.

Notice, too, that the Opel 1900 gives you rear, swing-open side windows as standard equipment.

An important comfort in ventilation that we thought you'd like.

But maybe you want an economy car just for the great gas mileage and easy handling. The Opel 1900 gets great gas mileage and we turn tight... 31.8 feet with only three turns of the wheel.

See all the Opel 1900s (1900 sedan, 1900 sport coupe, the zoomy 1900 Rallye and the beautiful 1900 wagon) at your Buick-Opel dealer's. Over 2,000 of them sell and service Opel from coast to coast.

After you've seen all the new Opels, if you can find an economy car that you think gives you more than Opel, congratulations.

You've done a lot more than we could.



BUICK MOTOR DIVISION

Opel 1900 station wagon in antique bronze, foreground.

BUICK'S FOREIGN ECONOMY CAR.

What Ever Happened to Air Bags?

By government order, passive restraint systems are on the way. We'll all foot the bill because we've refused to use those lifesaving lap and shoulder belts!

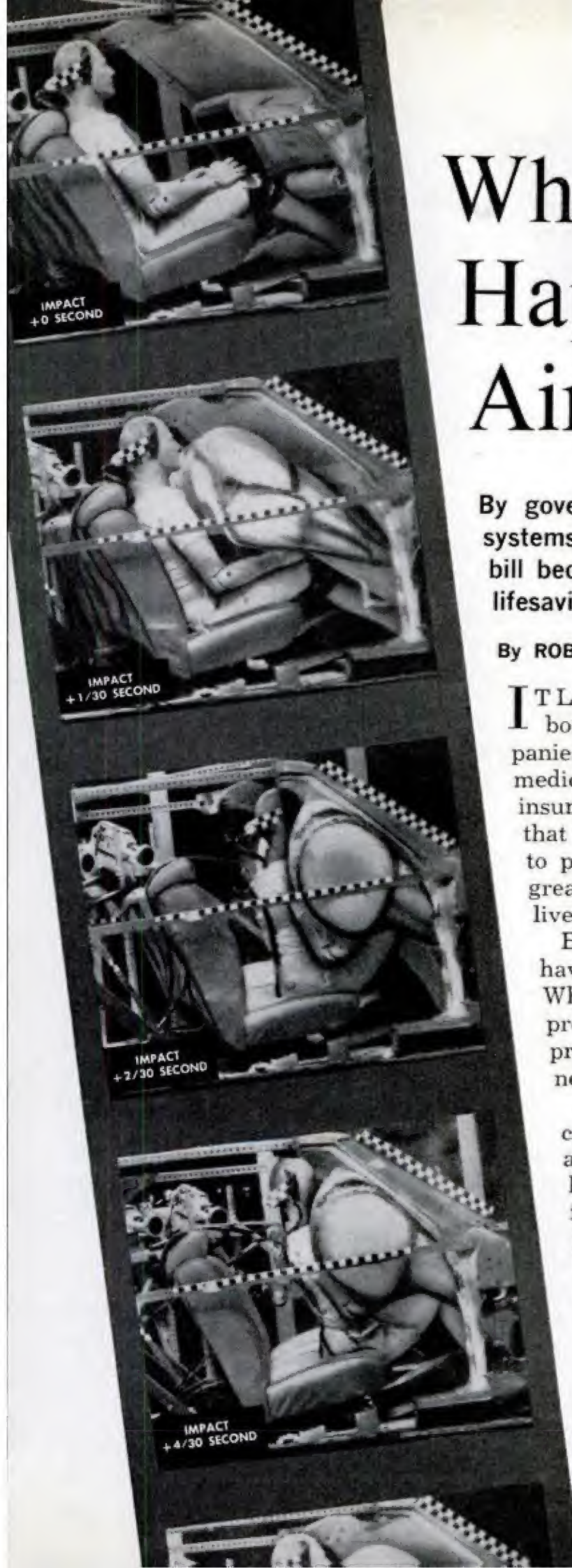
By ROBERT LUND, Detroit Auto Editor

IT LOOKS GREAT ON PAPER. Everybody—and that takes in the car companies, safety groups, government, the medical profession, police agencies, the insurance industry—one and all agree that the pillow that pops out of the dash to protect the torso in a collision is a great idea. It could save thousands of lives.

But if the idea is such a winner, why haven't the bags been installed on cars? What's the holdup? When will auto producers put the pop-out pillows on production cars? Sooner, later or never?

The straight story on air bags, according to automakers, is that despite all the gung-ho and let's-go you've heard about them, the device is far from foolproof. Instead of saving your life, in certain situations the bags could turn killer. Or, second choice, maim you or make you deaf.

Is this another stall by Detroit, the old hold-'em-off-at-the-pass-trick? Champions of air cushions are convinced that's the case. They accuse the monsters of Motown of dragging their feet





PASSIVE RESTRAINT need not necessarily be the air bag. It can be any device or system that protects drivers and passengers without their having to take any action like buckling a harness. Firestone's research has resulted in a "blanket" system, shown here in a back seat. It snaps into place, pin is pulled for release

on a proven safety development that could prevent thousands of fatalities. It's the familiar accusation that Detroit puts profits above people, the villains gleefully conspiring against the public good.

That's plain stupid. The advocates of air bags who read conspiracy in Detroit's reluctance to put the equipment in cars couldn't be more wrong. The auto companies could actually profit by going along with the idea. Nobody knows what the bags will cost down to the dollar, and it would be an easy matter for the car firms to pad the price and pocket a profit. When air bags come the cost will be factored into the price of cars. You'll pay for them, so Detroit has nothing to gain financially by refusing to install them.

Automakers admit the potential benefits of air bags outweigh the negative risks. They'll definitely do more good than harm. Save more people than they'll kill or cripple. What the auto companies are asking for is time to try to engineer out the harm that does pose a threat or at least minimize it.

The do-it-now-ers make the valid point that air bags aren't a new idea, an untried, untested hypothesis still wet behind the ears. The concept has been around a long time. A research engineer at Martin Aircraft, Carl Clark, captured the interest of the aircraft and auto industries with his idea of a cushion that would automatically pop out to catch passengers in a collision more than a decade ago. In 1965, a Japanese, Yasusaburo Kobori, president of the

Good Idea Center in Tokyo, visited Detroit and demonstrated his inflatable restraint system. The auto companies have been experimenting with the idea off and on for several years.

One drawback of the early bags was the lack of a reliable sensor. A sensing device had to be developed that had the capability of distinguishing between a real collision and a nonaccident impact so the bag would inflate at the right time, only at the right time and soon enough to protect the passengers.

Activating an air bag isn't a simple operation. Inflation is accomplished by a system consisting of six components, the most essential of which is the sensor. Mounted on the car's firewall, the sensor must "decide" when the car has been in a collision equaling a barrier crash of eight miles an hour or more.

Based on the principle that "a body in motion tends to stay in motion," the sensor—a little larger than a golf ball—has a tiny spring that presses against a metal weight that must move forward about a half-inch, thereby completing an electrical circuit. It's a lot like a typical G-switch, except that deceleration must continue long enough.

A couple of electric wires carry this "message" to a high-explosive cap on a bottle of nitrogen gas mounted behind the instrument panel. The gas is stored at a pressure of 3500 pounds per square inch.

When the cap explodes, the nitrogen rushes out into a "distributor," a sort of pipe with slits that quickly distributes



CRASH TESTING and safety research at Volvo has led Karl-Erik Larsson, assistant manager of the passenger car division, to comment that air bags must never replace seat belts. Air bags cannot protect occupants in all crash situations—roll overs, for example. One study of auto accidents in Sweden has shown that when belts were worn there were no fatalities at speeds up to 60 mph. When seat belts were not worn, fatalities occurred at speeds as low as 12 mph! Volvo, nevertheless, is working on the air bag since the U.S. federal safety standard requiring a passive restraint in the front compartment by July 1, 1973, will apply to imports, too

the nitrogen to a large coated-nylon bag folded up in the instrument panel.

All the action must occur in a fantastically short time—40 milliseconds, or four percent of a second. In a typical collision, this is the approximate time between the first collision and the start of the passenger's forward movement on the seat that becomes the second collision. To give you an idea of how fast the device must work, a sneeze usually lasts about 500 milliseconds (half a second) and the blink of an eye takes about 100 milliseconds.

In the mid-1960s, a Cleveland-based auto supplier, Eaton, Yale & Towne, launched a \$5 million program to perfect an air bag for automobiles. Now, some six years later, Eaton claims to have a practical system. The guts of the system is a nitrogen bag. Eaton calls the package Auto-Ceptor.

The company achieved the necessary speed to activate the bag in the split second between the first and second collisions partly by using a high explosive to pulverize the plug in the nitrogen bottle. PETN, the explosive agent, burns at a rate of about 3000 meters a second. A quantity about the size of a .22-cal. shell is used.

In the course of its development program. Eaton discovered there is a relatively prolonged impact when a car is in a collision compared with the short impact produced when a vehicle hits, say, a six-inch timber at 60 mph, or when someone slams the hood down hard, or any other nonaccident impact to which cars are subjected. Eaton's

sensor can tell the difference between the prolonged crash that takes place in a collision and a shorter, noncollision impact.

To demonstrate the efficacy of the sensor, Eaton conducted tests showing that even in the most severe noncollision impact, the sliding weight in the sensor never moved more than 10 percent of the distance necessary to trigger the system.

In another test at Holloman Air Base, baboons were strapped in impact sleds and subjected to high-speed stops. A 40-G stop will usually kill a baboon. With the Eaton system, the animals survived 60-G stops with virtually no injuries.

With this wealth of background, history and experience, it's easy to understand why advocates of air bags are impatient with Detroit. Why not now?

Because the auto companies still have some serious misgivings about the device.

"There's no problem building and installing an air bag in a car," John Beltz, the engineer who heads up GM's Oldsmobile Div., told *PM*. "The problem is to install them in nine or ten million cars and have every one work right every time." (From another source, *PM* learns GM has developed its own bag. The GM cushion runs the entire width of the front seat, instead of individual bags popping out to shield each passenger.)

The auto firms want answers to six

(Please turn to page 168)

Big Year for the



Little Guys?

"BIG-GUY" BUDDY BAKER takes hot ride in Dodge Daytona before carb-plate rule. Only driver with Dodge factory ride, he'll run '71 Charger; Richard Petty's in only factory Plymouth. No factory Fords will run

The independents who race in NASCAR's Grand Nationals have always had pretty rough running, but with the factory pullouts and the rule changes this could be their year!

By BILL HARTFORD, Auto Editor

"WOULDN'T IT be something," grinned independent racer-of-fortune James Hylton, "if a \$25,000 operation like mine beat Isaac's million-dollar operation?" That was before the factory axes fell and left Isaac's "million-dollar operation," along with several others, just a bucket of parts and pieces and no big bucks.

Yeah, wouldn't it be something! It

would even be better than last year when Pete Hamilton (who?) streaked out of the blue to out-Petty Richard and all the other hot dawgs. Imagine, an independent, do-it-yourselfer like Hylton, or Neil Castles or Dick Brooks, or any one of a dozen others picking up all the chips at the Big D!

The factories have sworn off fueling those fat Holman & Moody-Matthews-



BROOKS

CASTLES

CHAMPION

GLOTZBACH

HAMILTON

HASSLER

HYLTON

Nichels - Hyde - Owens - Rossi - Johnson-Wood operations, folded their programs and gone back to Detroit to worry about safety, ecology, and just plain making cars for the rest of us less speedy drivers. For 1971 Ford and Chrysler are more worried about Volkswagen and the Japanese than they are about each other—or, for that matter, General Motors.

This means, for the little guys, "Daytona's the place if you wanna race!" That's how the bumper sticker reads and that's how NASCAR boss Bill France feels about the factory pullouts: good for the independents.

Despite factory pullouts in the past, stock-car racing has done nothing but grow. The 1971 season will see the total GN purse hitting almost \$3 million—up again for the 21st consecutive year. The Daytona 500 (along with the inaugural Golden State 500 at Ontario and the World 600 at Charlotte) gets a lion's share of this total. France regards the loss of auto-company money as only opening the door for sponsorship from companies not in the automotive field—a trend that has steadily been gaining ground. He also anticipates better competition because, as he says, "More owners and drivers will have an opportunity to be competitive at a much reduced cost."

Cost is always an all-important consideration. In fact, there is probably some secret, extraordinarily complex equation that relates car reliability and mph to m-o-n-e-y. The top teams and drivers will still have more bucks for more bang because *someone* will kick in where the factories have bowed out. K & K Insurance, for example, will

still back Bobby Isaac, last year's GN champ, and his car handler, Harry Hyde, but Dodge won't be helping him this year. (What profiteth the Grand National champion if he win the crown but loseth his sponsor!)

Nichels Engineering will probably continue to field a car with Dow Chemical support but will have to scrounge, now that Chrysler decided not to renew Nichels' contract to distribute high-performance parts, blueprint hemi engines and build stock cars. Ray Nichels and former star Paul Goldsmith prepared Charlie Glotzbach's Dodge last year.

Other top teams scrapped by Dodge include Cotton Owens/Buddy Baker and Mario Rossi-Bobby Allison. Ford Motor's four-car factory effort written off last November included Holman-Moody/David Pearson, Banjo Matthews/Donnie Allison, Junior Johnson/Lee Roy Yarbrough and Wood Brothers/Cale Yarbrough. This sparked Cale to abandon NASCAR for USAC. Lee Roy may do the same.

Pete Hamilton, fair-haired hero of last year's down-to-the-wire duel with fast and foxy David Pearson, became an instant independent with Chrysler's consolidation of one Dodge and one Plymouth into Petty hands. Buddy Baker got the Dodge driving assignment, and Richard Petty the Plymouth. (Richard was recently appointed by President Nixon to the Advisory Conference on Physical Fitness and Sports.) Buddy, son of the former stock-car driver, Buck Baker, held the world's closed oval record with 200.447 mph until topped by Bobby Isaac's 201.104 mph.

At this writing (right after the Ford



LANGLEY

MARCIS

PARSONS

SCOTT

SEIFERT

THOMAS

WARREN



DAVID PEARSON in Holman-Moody Ford was testing a '71 when Ford announced it wasn't buying the gas

announcement and the Tidewater 300, last GN event of the '70 season), the orphaned teams are looking for "investors" to replace Big Daddy Detroit. Now *everybody's* an independent. The little guys, who have been independents for years, may actually have an edge. Most of them have been getting along on a shoestring for years. They are used to fabricating their own parts and skipping lunch now and then.

The other big factor this year is the rule changes, the effects of which are yet to be revealed. The most important part concerns engines. The Automobile Competition Committee of the United States (ACCUS) has set the maximum engine size at six liters, or 366 cu. in., to maintain an equality of competition. The 366s will run with

one four-barrel carb with 1-11/16-inch venturis in a car weighing 3800 pounds minimum.

Additions to this rule make allowances for teams with investments in existing engines and bodies. The 426 hemis and 429 Fords (within the old seven-liter, or 430-cu.-in., limit) can still run this year, but with a carburetor-restrictor plate which cuts the venturi to 1¼ inches. Minimum weight for them is 3900 pounds.

And, get this, those 200-mph special cars—aerodynamic Daytonas, Superbirds, Talladegas, Cyclones—are also eligible, but their engine size is limited to a piddling five liters, or 305 cu.in.! They can run 100 pounds lighter this year (3800 pounds) and don't need the plate under a four-barrel 1-11/16-in. carb.

These rules are in keeping with ACCUS's intentions, announced two seasons ago, to establish the 366 rule without causing hardship on car owners who have an investment in exotic equipment.

By newsstand time it will be known who's running with what, but right now (Nov. '70), testing has only begun. Petty Enterprises has been running a '71 Charger with its hemi destroyed to the 366-cube displacement. Very likely, with the Holley four-barrel, it is getting as much or more horsepower as it would from the 426 with restrictor plate. The 366 free-breathing configuration should crank out over 500 hp while the plate has the effect of dropping hp of the big



CARBURETOR PLATE must be installed on 426 Hemis, 429 Fords. The 1¼-in. venturi, being checked with go/no-go gauge, restricts fuel/air flow to cylinders



CALE YARBOROUGH in the Wood Brothers Mercury Cyclone is an ex-factory driver. He's switched to USAC

displacement engines from around 600 to a bit under 500.

The "bit" varies from engine to engine as was found out during the 1970 season—the plate having been made mandatory by NASCAR just before the 400-mile race at Michigan International Speedway.

Teams will decide the way to go depending on their investment in engines and bodies and what they determine they can get from a 366 free-breathing versus an engine of 430-cube limit with the plate. The decreased venturi with the plate creates eddies in the flow of air and fuel through the intake manifold to the cylinders. Manifold design can help minimize, or straighten, the eddies, which has the effect of upping the hp.

Teams that elect to run the hemi may have an advantage over the 429 Fords in that the plate penalizes the higher revving Fords (greater air consumption), compared to the hemi with its higher torque and lesser need for air. Junior Johnson, one of stock-car racing's all-time greats, complained of this inequity after the National 500 at Charlotte last October—even though his driver, Lee Roy Yarbrough, won the race. Lee Roy "stood on it" all the way, but couldn't really run with the Dodges and Plymouths. He inherited the lead when they dropped out.

In the two short months between the end of the '70 season and Daytona (the first '71 NASCAR event, the Riverside 500, just run, is a road race) all the teams will have done intensive

development and testing for the best engine/chassis set-up for the super-speedways. But even near the end of last November, not all the programs were in full swing: David Pearson and A. J. Foyt, top Ford driver on the United States Auto Club stock circuit, had their testing of '71 Super Cobras squelched when they had to pack it in on orders issued from Ford. At least the independents won't have *that* happen to them.

In 1970 points standings, Bobby Isaac (first), Bobby Allison (second) and Richard Petty (fourth) were the only factory stars at the top. The rest of the point leaders were all independents: James Hylton (Ford), Neil Castles (Dodge), Elmo Langley (Mercury), Jabe Thomas (Plymouth), Benny Parsons (Ford), Dave Marcis (Dodge), Frank Warren (Plymouth), Cecil Gordon (Ford), Richard Brooks (Plymouth), John Sears (Dodge), Wendell Scott (Ford), Bill Champion (Ford). Steady finishers all, but only one triumph among them: James Hylton at the Richmond 500, and that only after running 188 GN events without a win!

Meanwhile, the list of top money winners for 1970 season includes only the big guys who've gone after the big-purse races in FACTORY cars. Will they win again this year? Or will the factory pullouts and ACCUS engine rulings, indeed, as Bill France predicts, equalize competition for all contestants? The starting grid for the Daytona 500 is anyone's guess. ★★★



Leg stretcher

Two boards mounted on rollers and joined with two flexible cables make up a new exercise device that's intended to keep the user's legs in shape. The unit is called Shape-O-Matic, and, judging from the lady in the picture, lives up to its name.



Shark Hunter lives up to name

A 16½-foot tiger shark hangs above the submersible from which it was shot during a shark tournament off the Florida coast. The 1430-pound shark, largest of 69 killed during the contest, was shot by Pete Chase riding in a Perry Cubmarine *Shark Hunter*, with John Perry Jr., its inventor, at the controls. (See *Should Your Next Boat Be a Submarine?* page 75, Aug. '70 PM.)



Rubber bullets for rioters

British soldiers now are using rubber bullets to help stop riots. The large projectiles are fired from the same "gun" that they use for firing CS tear gas. The rubber shell is aimed at a depressed angle so that it bounces upward and tends to sweep the feet from under the rioter. The rubber bullets were first used in Hong Kong.



Tube for 250,000 talkers

The waveguide, a two-inch tube, will someday carry 250,000 telephone calls simultaneously. Buried, Bell's waveguide system will guide high-frequency radio waves carrying voice, data, TV and Picturephone signals.



Fast and faster . . . and Harley holds the world record

Shortly after the Yamaha machine (bottom photo) set a land speed record for motorcycles of 251.924 mph, the Harley-Davidson (top photo) zipped over the Bonneville flats at a new world record of 265.492 mph. The Yamaha, powered by two in-line 350-cc Yamaha engines, was driven by Don Vesco. The Harley-Davidson, powered by one 89-cu.-in. Sportster engine, was driven by Cal Rayborn. The streamlined record-holder was designed and built by Dennis Manning, Long Beach, Calif. Its monocoque shell is 19 feet long.



Strap-in radio console

The Two-Way Consolette, designed by Lt. Arliss Boothe of the Iowa Highway Patrol, is simply strapped into the seat beside the driver to provide accessibility of radio and police equipment. It's made of Royalite.

FEBRUARY 1971



Midget car for town

A new German "city car" comes in two-seat and four-seat versions and features an aluminum frame covered with plastic-coated sheet metal. Engine options are 14 and 20 hp. The car was designed and will be produced by Walter Schatzle (shown).

Cassette or Cartridge: Which Tape



The battle still rages, with exciting new developments on both sides. Here's a look at some of the latest models with tips on which system may suit your needs best.

CARTRIDGE CHANGER

plays 12 8-track tapes consecutively—up to 13 hours' uninterrupted music. Qatron is priced at \$329.95, also comes in model for use in cars

HOW FAR CASSETTES HAVE COME is indicated by highly sophisticated 3M/Wollensak recorder designed especially for synchronizing sound tracks with slides. It's \$299.95



THE INTRIGUING MACHINES you see above on these pages are just two of the many exciting, imaginative designs manufacturers are coming up with to entice hi-fi buyers to either cassette or cartridge tape. On the left you have Qatron's slick, rotary cartridge changer capable of playing up to 12 eight-track tapes nonstop—13 hours of uninterrupted music without your lifting a finger. On the opposite page is Norelco's ingenious flop-over cassette changer that plays a whole stack of tapes on both sides, also providing a virtually endless music source.

Such highly sophisticated machines are an example of today's rapidly growing trend toward deluxe cassette and cartridge equipment. Whichever system you choose, one

Machine for You?

By WALTER G. SALM

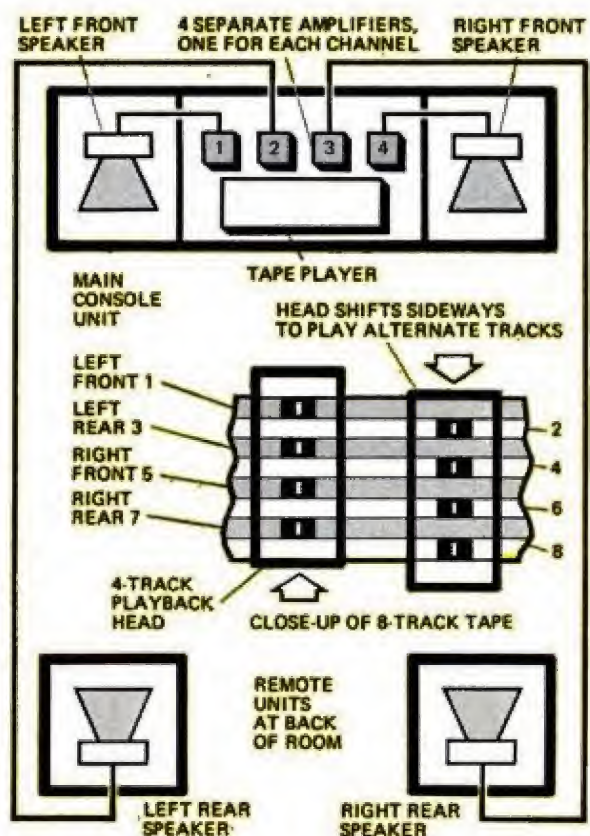


FLIP-OVER ATTACHMENT for cassette changers (above) turns each tape as it's played so opposite side will play without your having to reverse the stack. Cassettes feed up and over a small ramp, returning to the stack upside down. This ingenious plastic accessory, sold by Norelco for \$19.95, fits several Norelco, Ampex and Bell & Howell changers

thing is clear—mini tapes have grown up from curiosities to serious hi-fi. The better machines rival reel-to-reel recorders in sound excellence and far surpass them in convenience. Many fine receivers and compacts now include a cassette or cartridge player as a basic part of the entertainment package. You can also get trim, tabletop tape decks that play cassettes or cartridges through your existing hi-fi system. Prices in the \$200 to \$300 range are not unusual for such high-performance equipment.

Cassettes and cartridges have fought valiantly to overcome inherent disadvantages in their respective designs. The problem has been one of basic

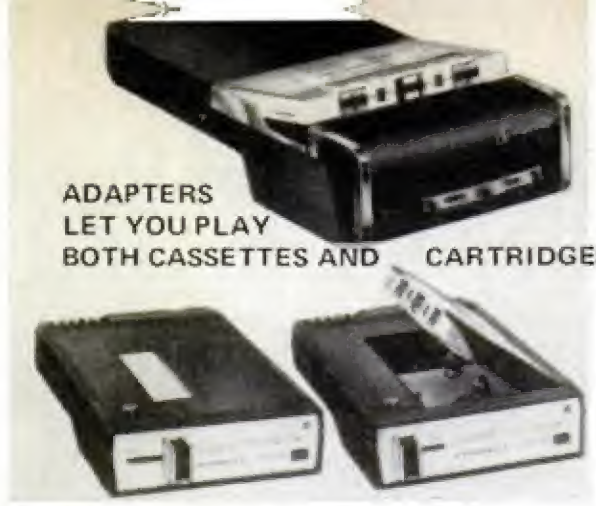
NEW 4-CHANNEL SYSTEM, developed by RCA, feeds four speakers simultaneously for rich, room-filling sound. Tapes are standard 8-track cartridges, but with four tracks recorded in each direction. Diagram at upper right shows how tape head shifts sideways to play each set of tracks. Idea is expected to spark new interest in 8-track cartridge format





POCKET MODELS
GET SMALLER AND SMALLER

NOT MUCH BIGGER than a pack of cigarets, these mini-cassette recorders slip into a coat pocket for easy carrying, are ideal for camping and travel use. Westinghouse at left and Admiral at right are both \$89.95. Both also operate on batteries or a.c.



ADAPTERS
LET YOU PLAY
BOTH CASSETTES AND CARTRIDGES

BRIDGING THE GAP between cassettes and cartridges are adapters like these that let you play both. You slip a cassette into the adapter, then insert the adapter into a cartridge player. One at top is made by Boman-Astrosonix, one at bottom by Panasonic

FANCY NEW TABLE MODELS OFFER
ADDED FEATURES



Harman-Kardon CAD5
Cassette Deck



Panasonic
Essex Compact
with Cassette
Recorder



Panasonic
Manchester
Cassette Changer



Craig 3303
Receiver with
Cartridge Recorder

differences in concept and application. Cartridge machines were designed primarily for playing, not recording, and became popular when Detroit started building them into the dashboards on cars. Cassettes originated mainly for voice recording in small, portable models you could sling over a shoulder. Cartridges, readily reversible for playing in both directions, offered the multiple tracks needed for stereo; the early two-track cassette was basically monaural and not reversible. Cassettes were big for recording, cartridges for playing. It simply came down to which you wanted most.

Now both cassettes and cartridges are borrowing tricks from each other. You can record on eight-track cartridges and listen to stereo on four-track cassettes. Which you pick depends, somewhat, on what you already have. If you've invested in cartridges for a car player and want to hear them at home, you'll consider one of the many attractive cartridge decks or self-contained cartridge players that

TYPICAL OF TODAY'S high-quality cassette and cartridge systems are those swank, versatile table models designed for hi-fi installations. Harman-Kardon CAD5 cassette deck at top incorporates new Dolby noise-suppression circuitry, is \$229.95. Panasonic's Essex is complete entertainment center with cassette recorder, record changer and AM/FM stereo receiver. It's \$349.95 with speakers. Manchester model, also by Panasonic, is stack-loading automatic cassette changer for \$229.95. Craig model at bottom combines AM/FM stereo receiver with 8-track cartridge recorder that both plays and records in stereo. It's \$249.95, including speakers



GO-ANYWHERE PORTABLES COMBINE RADIO WITH TAPE

NEW HYBRID PORTABLES offer both AM/FM radio and built-in tape units in trim, play-anywhere models powered by batteries. All three shown here record as well as play cassettes. Ampex Micro-34 at left is \$119.95. Craig Model 2609 at center features a

swing-out right-channel speaker that can be removed for greater stereo separation. It's \$179.95. Panasonic Royal-Aire at right has optional bracket for car installation, is \$125. Adapters are available for operating portables at home on a.c. house current

include their own amplifier and speakers. Makers like Craig, Panasonic and Lafayette offer eight-track machines that both play and record in stereo—relatively new for cartridges. Prices range from under \$100 to about \$250.

perts believe cassettes will eventually elbow cartridges off the market.

If you're starting from scratch, you'll find a wider selection among cassette machines. Cassettes, steadily rising in popularity, have brought significant advances in technology. New record/playback heads with higher frequency response, improved tapes designed especially for the narrow cassette track width, and smoother transport drives powered by house current instead of batteries have all combined to give cassettes a strong boost over cartridges. Cassettes are also smaller, handier and hold considerably more material. Because of these characteristics, many ex-

Cartridges still hold an edge in one important respect, however—their frequency range is greater. They go up to about 15,000 cycles, compared to 12,000 or so for cassettes. This added response is generally unappreciated in the noisy surroundings of a car, but can be a plus in a hi-fi system. Manufacturers are still playing it cool. Most offer a variety of models in both cassette and cartridge formats as a safe hedge.

One recent development that's giving cartridges a shot in the arm is four-channel stereo, known as quadrasonic sound. Here, four tracks are recorded simultaneously. Each feeds one of four separate speakers—two at the front of the room, as in conventional stereo, and

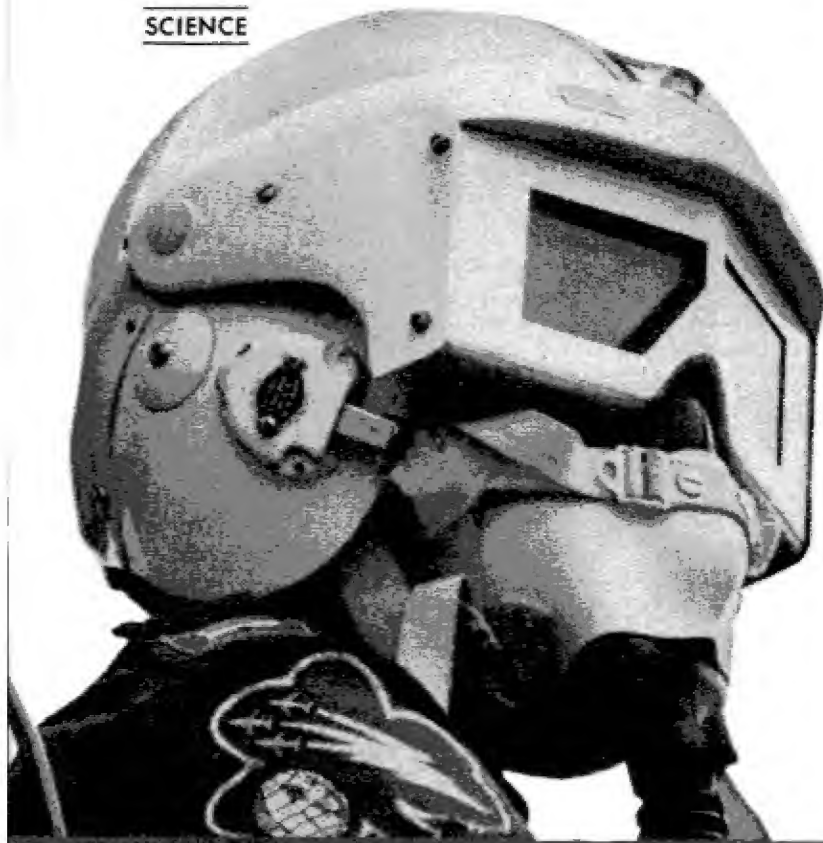
(Please turn to page 172)

NEW IDEAS IN UNDER-DASH CAR PLAYERS



YOU CAN PLAY BOTH cassettes and cartridges interchangeably on the versatile two-way Aiwa model at left, above. Price is \$159.95. Novel floor-mounted Craig stereo cartridge player at center can be

locked against theft, is \$179.95 with optional FM stereo radio or \$119.95 without radio. At right, Ampex Micro-44 combines stereo cassette player and FM radio in one under-dash unit priced at \$199.95



They Like 'Impossible' Jobs

EG & G spells 'Egg' in scientific circles, a company whose can-do eggheads will take on the tough ones whether they're deep down, close up or far out.

TO PROTECT AGAINST NUCLEAR FLASH, EG&G developed goggles with lenses that automatically darken

By NORMAN CARLISLE

A 175-POUND MAN, at least 10 pounds overweight, has finished a tough day at the office. On the way home he has a bad scare when a wild driver barely misses his car.

How does the man's heart react? What does the sudden stress do to his blood pressure? In a laboratory near Washington, D.C., scientists and engineers have whipped up a machine that shows exactly how the human circulatory system reacts in this situation.

- Off the coast of Massachusetts, a mile down in the dark waters of the Atlantic, lies the lost *Alvin*, a tiny research sub that sank in an accident. Hopeless search? Not at all. Men aboard surface craft have a marvelous seeing eye—a camera and light system that takes thousands of brilliantly detailed shots of the sea floor and spots the lost sub.

- Neil Armstrong and Edwin Aldrin rise from the moon's lonely surface to rendezvous with the spacecraft that will take them back to earth. How do they spot the command module? By a

brilliant light that's on it, a powerful space beacon put together by a group of scientists in Massachusetts.

Remarkable as these scientific activities and achievements are in themselves, even more remarkable is the fact that all the scientists and technicians work for the same research organization. And 10 to 1, it's an outfit you've never heard of, though it represents one of America's biggest aggregations of scientific brainpower, with 10,000 employees in labs and installations across the country, from Bedford, Mass., where it's headquartered, to Santa Barbara, Calif. It's EG&G—called, understandably, "Egg" in scientific circles. The initials are those of three electrical engineers from MIT—Harold Edgerton, Kenneth Germeshausen, Herbert Grier—who founded an instrument firm after World War II.

It really began with a hobby of Edgerton's—photography, a field in which the adventurous scientist started probing two new realms, high-speed

and underwater picture taking. He and his associates developed a superpowerful stroboscopic photography system that amazed the world with its millionth-of-a-second exposures using flashes of electronic light.

As use of the equipment spread, the three found themselves so busy helping out fellow scientists that they decided to set up a company. Soon government and industry were tossing all kinds of instrumentation problems at the can-do scientists and the bright young men they had gathered around them.

One thing led to another. Jobs EE&G took on demanded special hardware, complicated stuff no one was making. So, the company found itself producing mechanical sealing units for use in submarines, spacecraft, and the savage environments of chemical plants; acoustic transducers that pick up undersea sounds; medical devices, like an electronic artificial arm (*The Amazing "Boston Arm,"* page 102, Mar. '69, PM).

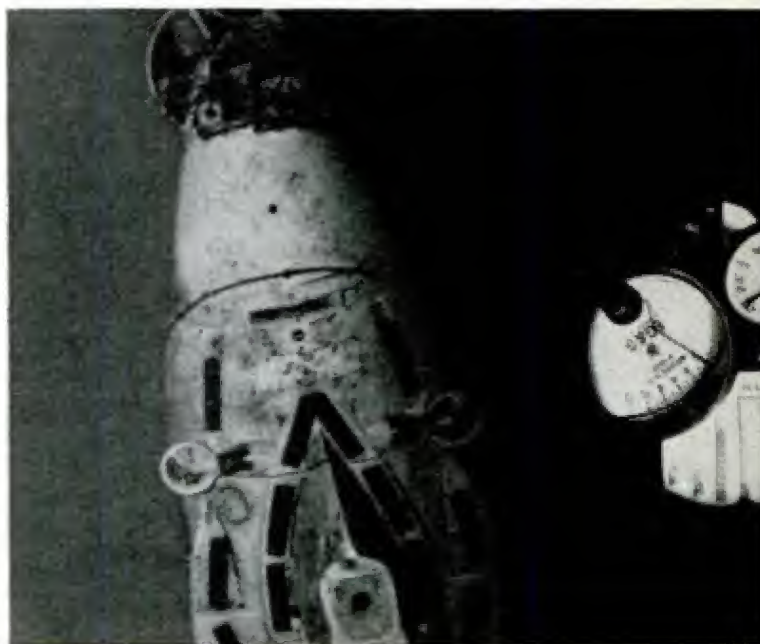
Today, highly sophisticated EG&G strobe systems are versatile tools of modern scientific photography. They played the key role in the greatest sea search in history, when 40 ships with 6000 men scoured the Atlantic in 1963 for the lost submarine, *Thresher*. With hardly a hint as to its location, predictions had been made that the sub would never be found.

When Adm. Thomas Moorer made the terse announcement, "The submarine's location has been confirmed by means of remotely controlled underwater photography," he was referring to EG&G's underwater camera, strobe and seismic system. Housed in a shell that can withstand the pressures of the ocean deeps, the unit can take 4000 underwater pictures without being brought up for reloading. What makes it possible at all is the powerful strobe that lights up the sea. This same rig spotted the *Alvin* (*How We Raised the Alvin From 5000 feet,* page 92, Jan. '70 PM), and the ill-fated *Scorpion*.

Another EG&G strobe enabled the astronauts of Apollo 11 to take stereo-



ARMED WITH COMPUTER and \$150,000 worth of instruments, scientists in plane study the atmosphere



SHARP-EYED CAMERA spotted Alvin at 5000 feet. Camera's time and position dials appear at right

SHOT OF SEA FLOOR at 10,000 feet was made by EG&G's amazing camera during search for *Scorpion*





RADAR INSTALLATION IN COLORADO is used to track high-flying balloons for wind computations and to scan for precipitation echoes. Work is part of research involving the seeding of wintertime snow clouds

scopic close-up pictures of the moon's surface. Shortly before the epic flight EG&G got a rush call. NASA scientists had decided that for the close-ups that would be taken by a Kodak-designed camera they'd need a controlled light source with known conditions of color, quality and intensity. Did EG&G have a strobe that would serve the purpose? One weighing no more than a pound?

"We don't have one, but we'll make one," promised Claude Brenner, general manager of the Bedford labs.

In 90 days, NASA had its strobe—a tiny item that weighed in at exactly one pound. On the historic moon flight it did its job, delivering 400 footcandles of illumination onto a three-inch square of lunar surface in flashes lasting 250 millionths of a second.

The EG&G engineers had more time to develop another strobe that played a big part in making the Apollo 11 rendezvous in space possible. From the days of Gemini on, powerful strobes have provided the flashing beacons that help guide spacecraft. The beacons can easily be spotted up to 50 miles away, showing as brilliant points of light much brighter than the stars.

Off Sandy Hook, N. J., where a lightship once was anchored, stands a tower topped by a new kind of light that guides ships toward New York

harbor. It's an EG&G strobe, which, from dusk to dawn, flashes 20,000 times with 600,000 candlepower. That's on clear nights. When the fog clamps down, the brilliance automatically steps up to 6 million candlepower. The complicated arrangement of xenon flash tubes, reflectors and controls, which took years of development, works so well that the Coast Guard is replacing all other types of beacons with strobes.

Brilliant as this light is (the most powerful earlier lights could produce only 2.5 million candlepower) it can't hold a candle to EG&G's greatest triumph of brilliance—the superpowerful strobe beacons at Woods Hole, Nantucket and Martha's Vineyard, Mass. These lights, which guide ferries across narrow, treacherous channels in the heaviest fogs, turn out an amazing 60 million candlepower!

One of the most difficult jobs EG&G ever undertook was that of finding a means, not of creating brilliant light, but of keeping it out. The Air Force needed goggles that would automatically close when subjected to the light from a nuclear detonation. A man could easily be blinded by such a flash at distances much greater than those at which he'd be harmed by shock waves or radiation.

"This was a tough one," says slow-

spoken, thoughtful Kenneth J. Foster, engineer who started the project. "We had to go into a lot of fields—ophthalmology, optics, atmospheric transmission of light, chemistry, electronics, mechanics, nuclear effects and even human engineering."

Requirements were exacting. Needed was a shutter that would close within 100 microseconds of the detonation and open within a few seconds afterwards so the man with the goggles could continue with his work. The shutter had to be reliable under all light conditions, from full sunlight to darkness. It had to tell between light from nuclear sources and ordinary light.

EG&G came up with a goggle system employing chemistry and electronics. The active material in the shutter is a small quantity of a photochromatic chemical in solution. The solution, ordinarily clear, becomes colored when exposed to ultraviolet light emitted by two xenon flashtubes responding to the flash of a nuclear detonation.

The goggles are a relative of an earlier device that rates as one of the most complex pieces of gadgetry in the EG&G arsenal. After World War II, during which Edgerton, Germeshausen and Grier applied their electrical wizardry to the Manhattan Project, the AEC wanted pictures of nuclear bombs at the moment of explosion. But the blinding light of a nuclear blast makes a conventional camera useless.

EG&G solved the problem by inventing a shutter called the Rapatronic. The shutter includes a coil of wire wrapped around a cylinder of glass placed in front of the camera lens. When the nuclear weapon is triggered, a pulse of current is released from a strobe condenser unit. The current rotates the polarized glass cylinder, allowing light to pass through for as little as one microsecond. Using this device, EG&G scientific crews went to Eniwetok Atoll to take the first pictures of an H-bomb being detonated.

With their expertise in sensitive trig-

(Please turn to page 114)



EXHAUST ROARS SKYWARD in desert during test in program to develop atomic power for space flight

BATTERY OF SENSITIVE DETECTORS on plane can pinpoint radioactive sources hundreds of feet below





DANGER IN THE HOSPITAL

In the growing field of medical devices, there are no standards of safety or performance. Until they are established, hospitals will have no guarantee that equipment will operate properly—or even that it won't kill you

By ARTHUR S. FREESE

Technical Art by Fred Wolff

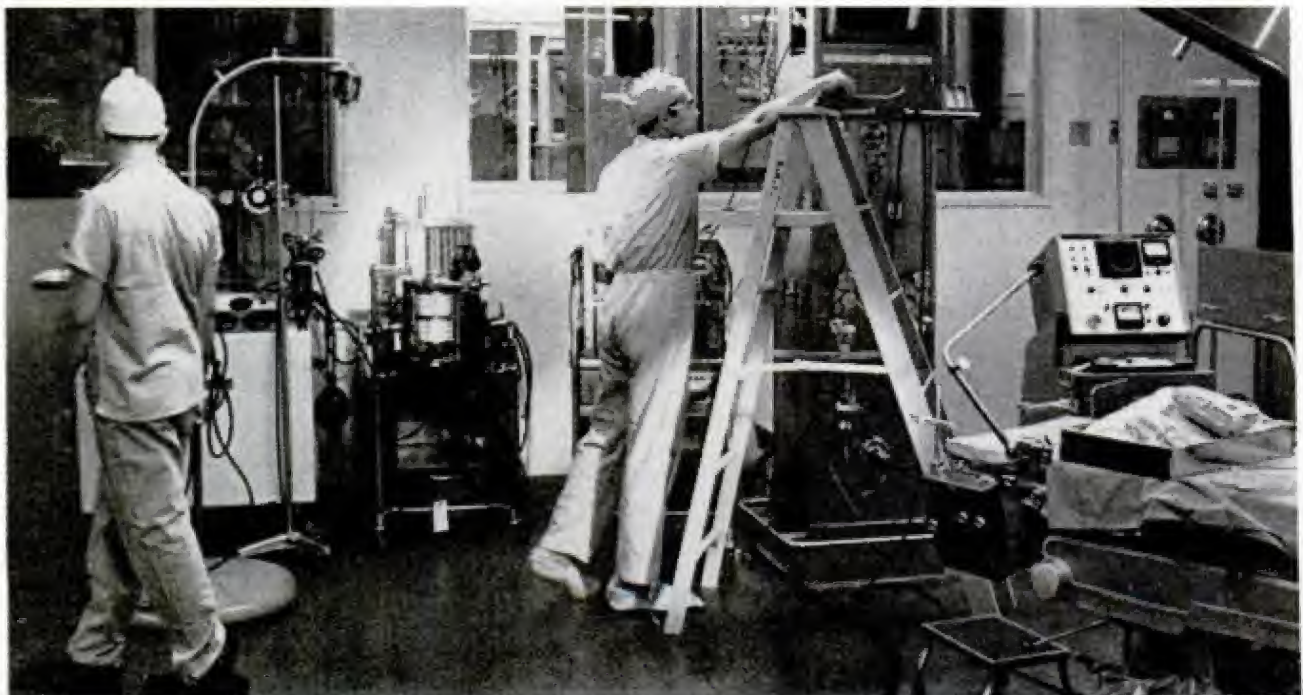
THE MAN was in his mid-forties and the doctors were fighting his cancer with radiation. Now he lay on the table awaiting a treatment. The massive X-ray machine was ponderously lowered over his chest—only this time the unit didn't stop when the switch was thrown. Before the technician could get across the room to the circuit breaker, the patient had been crushed to death.

the operating room of a hospital in the Washington, D. C., metropolitan area. Her routine thyroid surgery had been successfully completed and the surgeon was sewing up the wound. The doctor turned off the anesthesia machine. But there was an electrical spark—and an explosion whose full force hit the woman. Four-and-a-half hours later she was dead.

A woman in her mid-sixties was in

On the West Coast, a whole series

CALIBRATING AND TESTING operating room equipment at Downstate Medical Center, Brooklyn, N.Y., is daily occurrence. Seymour Ben-Zvi, director of Scientific and Medical Instrumentation, checks the TV monitor



of broken hips was repaired with a ball-pin device in which the ball was nylon. The plastic reacted with body tissues to form abscesses that failed to heal. Additional surgery was required.

A patient in a large East Coast hospital was operated on with an electrocautery while an electrocardiograph was attached to monitor the heart. When the operation was satisfactorily completed and the electrocardiograph leads removed, deep third-degree burns were discovered underneath one of the leads. It was even difficult to tell the extent of the burn at first because these tend to mushroom out and form a cone whose broad base is deep inside the tissues while the opening on the skin remains small—slow and hard to heal.

A large operating-room monitoring oscilloscope was recently returned from a factory-authorized service station. When first turned on, it caught fire.

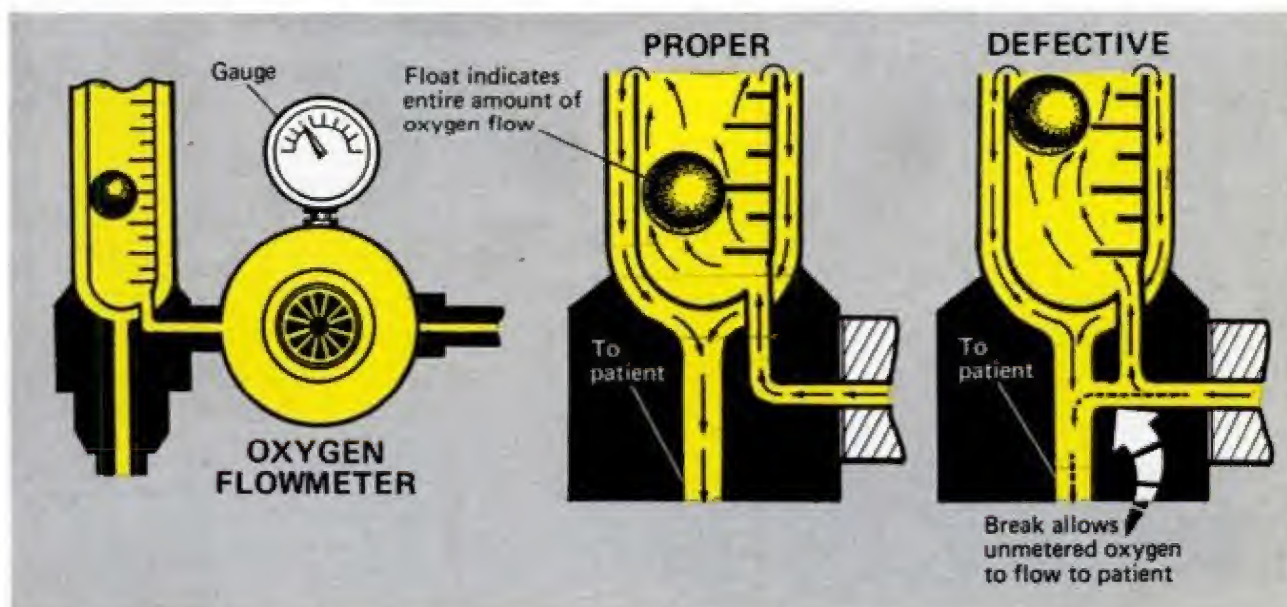
There have been artificial kidney machines which poured distilled water into the veins of patients, artificial heart valves with surface defects so that blood clots formed in these faults, metal implants—bone plates and screws—that broke or corroded in the body tissues, mechanical hip-joint replacements of such poor quality that additional corrective surgery was required. The plastics doctors use—both

inside and outside you—are only commercial-grade—none are specially made for medical purposes. Dr. Joseph Davis, director of Div. of Clinical Medical Devices of the Food and Drug Administration, told me he believes this is definitely dangerous and the reason patients get toxic reactions from plastic implants.

Even hospitals in major medical centers have admitted they have no central surveillance and testing by trained engineering personnel of medical equipment when it is delivered to the hospital. So it's not surprising that the experts speak of accidents in terms of 5000 patients being electrocuted annually—others of 10,000, 25,000—pick your own figure, no one can really dispute it. As Dr. Davis explained to me: "We know there are at least 5000 different medical devices, perhaps as many as 25,000. So out of 25,000 different type devices with X number of each in use, I think you would be hard put to say an occurrence couldn't occur with each device."

Yet in only a very few hospitals across the country (some say in only one) is there a department with trained personnel who routinely check every piece of medical equipment when it arrives and before use, then follow up with proper, regular maintenance. In

DEFECTIVE OXYGEN FLOWMETER on new equipment delivered to hospital as discovered by Ben-Zvi team. Defect allowed oxygen to bypass meter. Patient would have received 36 times more gas than meter indicated



this one hospital's department, for example, technicians obtain the operating-room schedule for the coming day and go over every unit of sophisticated surgical equipment to be used.

This unusual department is located at New York's Downstate Medical Center where Seymour Ben-Zvi is director of scientific and medical instrumentation. His department of two dozen people, including five engineers, tests every piece of equipment, when it arrives, to make certain it meets manufacturer's specifications and is safe and in good working condition. His precautions have repeatedly paid off.

Not long ago a shipment of 10 defibrillators arrived. These are electrical devices which literally "shock" a wildly beating heart back into its normal rhythm by delivering a 7500-volt short-duration pulse. Actually a simple instrument, it consists of a circuit which charges an oil-filled capacitor. The physician or nurse presses two paddles against the patient's chest. Pressing the discharge button causes a relay to switch the capacitor from the charging circuit and pour its full voltage into the patient. All 10 devices were de-

ELECTRONIC EQUIPMENT simulates patient in test of electroencephalograph (brain wave analyzer) in lab



fective—and dangerous! They had improperly degassed vacuum relays and their capacitors discharged without having the discharge button depressed. The devices could have been fatal to both operator and patient. One manufacturer's representative assured Ben-Zvi that the company stood behind these machines and would be happy to replace any defective ones.

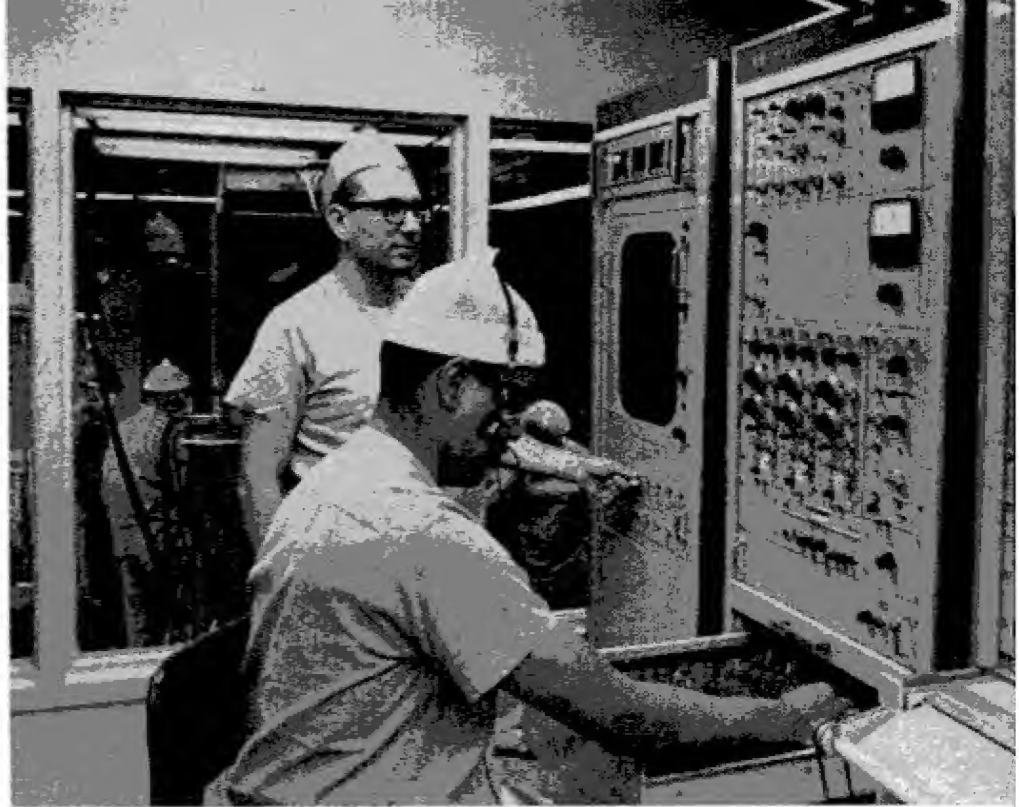
"But how will they replace the dead patient, or physician, or nurse?" asked Ben-Zvi.

Dr. Joel J. Nobel—scientific director of Philadelphia's Emergency Care Research Institute, also an authority in this field—points out that every one of the estimated 50-million people who annually enter U.S. hospitals has contact with medical instrumentation. If you have a heart attack you will be in close contact with nearly 400 different medical devices during your three or four-week hospitalization. If you are an average adult and enter a hospital for gall bladder surgery, you will be directly involved with over 600 devices, and if your child has his tonsils out he will be in contact with almost 200.

Dr. Nobel says that 30 to 40 percent of device failures are operator errors. There are more problems than just accidents—electrocardiographs which, in private offices, don't provide correct tracings because they're not calibrated, and instrumentation which gives incorrect diagnostic information. But Nobel believes it is possible "to set up failure systems so that when things do fail they fail in a safe position rather than in a dangerous position" and "to do many things to make instrumentation much safer, both on the part of industry and on the part of the hospitals and designers."

Ben-Zvi's unit at Downstate Medical Center checked several thousand pieces of incoming scientific and medical equipment in the past two years. About 40 percent of all those delivered were defective. These ranged from simple, but dangerous, inadequacies, such as lamps on extendable arms

CONTROL ROOM adjoining operating room of Downstate Medical Center contains array of electronic monitoring equipment typical of that found in most modern hospitals. Ben-Zvi and technician run daily maintenance checks on equipment before operating room is used



whose strut mechanism eventually severed its own electrical cord, to defective flowmeters which delivered 36 times more oxygen than the meter indicated—enough to explode a patient's lungs or do other damage, depending on the use to which this versatile equipment is put. Mechanical failures included devices not properly assembled, castings not checked before delivery, and other problems due to inadequate quality control—the same slipshod quality we find in our everyday lives, except that in medical devices this becomes a matter of life and death.

As Ben-Zvi explained it, there are two types of electrical hazards—the macro and the micro-electrical shock. The macro-shock is the big jolt you get when you touch an exposed power line in your house. It electrocutes by actual tissue damage and heart fibrillation—an uncontrolled wild runaway beating which is so inefficient that the body cannot be adequately supplied with blood. In a minute or so, permanent brain damage can result and in about three, death. Micro-shock, predominant in the medical environment, is a newer hazard. It has been proven that as little as 20 microamps. (millionths of an amp., really a microscopic amount of current) of leakage current flowing through the heart is enough to

produce fibrillation even though it takes a thousand times this current to light the smallest incandescent bulb.

Ben-Zvi describes micro-shock as “an evasive sort of shock—evasive to the medical person who is not knowledgeable about the technical causes.” But a patient may die if fibrillation is not detected in time, as often happens. Most scientists working in this field agree that this internal electric shock is a subtle hazard that escapes recognition by most physicians. Accurate statistics on the accidents caused by medical devices will not be available until the law requires reporting of these deaths and injuries in every instance.

Responsibility for the lack of medical instrumentation safety is said by those in the field to be shared equally by government, manufacturers and medical profession. There is general agreement that federal legislation is essential but many are pessimistic about the chances for passage of current legislation. As Ben-Zvi puts it: “It always gets bogged down somehow.” In the last analysis it will be the public's demand for protection that will determine the fate of any effective legislation to insure the safety of medical devices and equipment. Until passage of such laws, you are in danger nearly every time you enter a hospital. ★ ★ ★

Wrap a Ring Light Around

These circular electronic flash attachments are just great for giving an even, shadowless light, but they aren't for all shooting. Here's what you ought to know about them

ONE OF THE STRANGEST-LOOKING PIECES of photographic equipment is a small, circular electronic flash tube, called a ring light, that literally wraps itself around the front of your camera lens. The effects it produces are as startling as its appearance. Harsh shadows, a major shortcoming of conventional top and side-mounted flashguns, magically disappear with a ring light. The result is a soft, smooth, uniform illumination that can eliminate many of the problems of ordinary flash.

Ring lights are made in models to fit most 35-mm single-lens reflex cameras. While they're not the answer for all flash shooting, they can be a handy aid if you do a lot of close-range photography. Regular flashguns throw their light downward or sideways across the subject, causing irregularities like a nose, chin or ear to cast deep shadows on the unlighted side. Such shadows block out detail and create a harsh, contrasty picture.

Because a ring flash surrounds the lens, it floods the subject with light from all directions at once. Light from one side automatically cancels out shadows that would normally be cast by light from the other side. Since the light encircles the subject, virtually no shadows can form at any point. The beam is also spread out instead of being concentrated in one spot. This avoids the washed-out detail and hot spots you frequently get with conventional flash at close range. Thus a ring light is ideal for shooting close-ups at two to four feet. The even, shadowless illumination brings out detail and is perfect for small tabletop objects, models, insects, flowers, coins, stamps and similar subjects. It's also useful for certain types of portrait photography. Four typical ring-light models



THREE TYPICAL FLASH RINGS are, left to right: Prinz Minicam Multi-Pak, \$59.95; Nikon SR-1, \$82.50; and Honeywell Prox-O-Lite 6A, \$49.50. Both Nikon and Honeywell units require a separate power supply, while the Prinz Minicam comes with self-contained power supply operating from batteries or house current

Your Lens

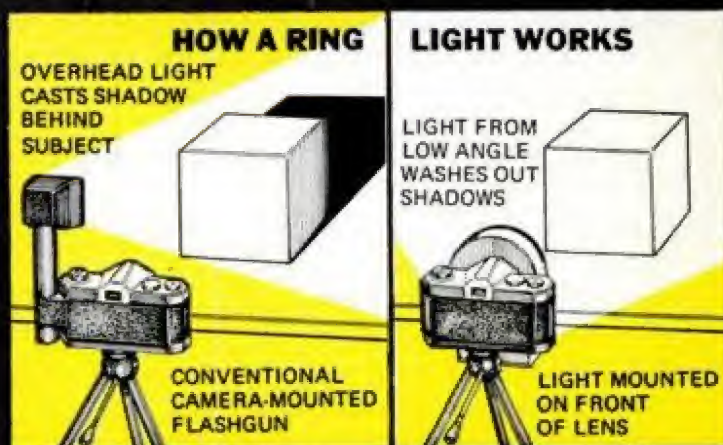
By **BURT MURPHY**

Photos by Robert D. Borst

CIRCULAR FLASH TUBE, fitted over camera lens, bathes subject in light from all directions at once. Drawings at lower right show how this cancels out shadows normally produced by conventional top or side-mounted flashgun. Model shown on camera here is Aimes-Hershey Sun Ring priced at about \$50



are shown here. These are the Nikon SR-1, Honeywell Prox-O-Lite 6A, Prinz Minicam Multi-Pak and Aimes-Hershey Sun Ring. Prices range from about \$50 to \$85. Each ring screws directly into, or slips onto, the end of the camera lens to hold it in place. For this reason, it's important to pick a model that will fit the lenses you have. The Nikon SR-1 is designed primarily for use with Nikon cameras and the Honeywell Prox-O-Lite for use with Pentax



cameras. Both, however, can be fitted to some other makes with adapter rings. Before choosing either model, be sure that such adapters are available for your camera. The Nikon SR-1 fits



HOW RING FLASH COMPARES with regular flash is shown above. Photo at left, made with conventional top-mounted flashgun, shows strong contrast with deep shadows under boy's chin and ear. Ring flash (center) eliminates shadows, but is still contrasty. For a softer effect, ring can be used as fill light (right)



MINICAM RING LIGHT has its own power supply, shown attached to base of camera in photo at left.

52-mm lens threads with a Nikon F mount. The Honeywell Prox-O-Lite is sized for 41-mm lens threads.

The Prinz Minicam and Aimes-Hershey Sun Ring are both designed to fit a variety of cameras. The Minicam has an adjustable clamping arrangement that can be varied to suit lenses 48 to 60 mm in diameter. The Sun Ring is threaded to fit a standard Series 7 or Series 9 filter holder. With adapter rings, it can also be mated to a Series 5, 6 or 8 filter mount. Series mounts are, in turn, available to fit most common lens sizes, either by screwing them in or slipping them over the barrel.

Your choice will also be determined, to some extent, by what electronic flash equipment you already have. This is because all but one of the units require a separate power supply. If you own a conventional strobe flash, you may be able to use its power supply to operate a ring light. If not, you'll have to purchase a power supply suited to the ring you select.

The Nikon SR-1, for instance, must be used with a conventional Nikon SB-1 Speed Light flashgun as the power source. The Honeywell Prox-O-Lite can be used



Plug-in jacks give choice of full, half or quarter output. Adapter for a.c. is shown in photo at right

with either a standard Strobonar flashgun as the power source or a separate power pack. However, the power pack is expensive—about \$80—and probably not worth the investment for occasional use. You're better off powering the ring from a conventional gun so you have both to work with.

The Aimes-Hershey Sun Ring can be operated from several battery or a.c. power supplies made by Aimes-Hershey or from some power supplies made by other manufacturers. It's designed for a 450-volt source with a 25 to 200 watt/second range. If you already own a power supply, check its specifications to see if it is suitable for use with the Sun Ring. The ring's connecting plug may fit other makes of power supplies, or you may find you need an adapter.

The one exception to the separate power requirement is the Prinz Minicam—a free bird, not tied to other units. It has its own power supply—a capacitor in a small housing that screws onto the base of the camera and a battery pack. You can also operate it on house current with an a.c. adapter. The Minicam is thus a good choice if you don't already have a



HOW SHADOWLESS LIGHTING improves appearance of small objects is shown here. In close-up of coin at left, details stand out clearly. In comparative

shots of model car, left-hand one, made with photo-flood, shows distracting shadows, while right-hand one, made with a ring light, is free from shadows



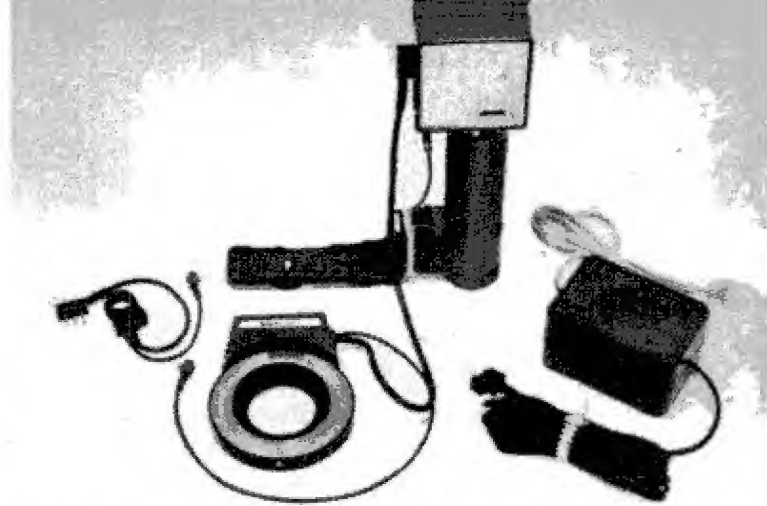
HONEYWELL PROX-O-LITE can operate from Strobunar flashgun (center) or a power pack (upper left)

conventional strobe flash or other power source.

The amount of light you get from a ring flash can be varied with most of the units, and this is a handy feature to have. It lets you reduce the brilliance of the flash at very close ranges to avoid overexposing the subject and washing out detail. A switch on the Nikon SR-1 gives you a choice of full or quarter output depending on your shooting distance. The Prinz Minicam has interchangeable connections that offer full, half or quarter output. The Aimes-Hershey Sun Ring can be operated at three or four different intensities depending on which power supply you use. Honeywell's Prox-O-Lite can be regulated for high, medium and low output when used with a power pack, but is limited to full output only when powered from a Strobunar flashgun.

Exposures with a ring light are determined in the same way as for conventional flash except that they become a little trickier at very close ranges. Manufacturers supply guide numbers for different ASA film speeds and different levels of light output. You select the appropriate number for the film speed and output level you're using, then divide it by the lens-to-subject distance in feet. The result is the correct lens f/stop to use. Shutter speed always remains fixed at the X synchronization setting as with regular strobe flash.

At close ranges below four feet, it's wise to bracket the indicated exposure by at least one f/stop on each side. For maximum depth and sharpness, it's usually best to use the smallest lens openings you can. However, if your exposure calculations work out to require a smaller



NIKON RING LIGHT plugs into a regular Nikon gun for power. Adapter for house current is at right

lens opening than you have available, it indicates that your light output is too high and that your subject will be overexposed. In this case, drop down to the next lowest output level and recalculate the exposure to find the appropriate opening.

A ring flash is ideal for candid close-ups where a conventional flash would be too overpowering. Its light is cool and instantaneous. Pets and children who won't sit still under hot, glaring floodlights can be caught informally and spontaneously with a ring flash. Delicate things that melt or wilt under intense heat, like plastic objects or flower petals, are other good candidates.

Ring lighting does have some drawbacks, though. By its nature, it tends to be flat, cold and clinical. It's good for recording precise details, but not for adding warmth and depth. By eliminating shadows, it also eliminates delicate modeling. Where you need highlights and shadows for contrast and character, you must go to floodlights or off-camera flash.

Ring lights also have a peculiar effect on eyes. The circular flash is reflected back into the lens, giving the pupils a strange, unnatural look. This makes a ring light unsuitable for formal portrait photography. For candid shots, you can solve the problem by catching your subjects at an angle or asking them to look away from the lens. You can also use ring flash as a fill-in along with sunlight or other light source for the main illumination. In this case, you expose for the main light rather than the ring. The ring light will soften shadows without flattening the whole picture.

A ring light can be fun to experiment

(Please turn to page 198)



Japanese electrics

Battery-powered vehicles bearing the names of some of Japan's largest manufacturers made a strong showing at the recent Tokyo Motor Show. Honda displayed an electric three-wheeler (upper left). Toyo Kogyo's EX005 (lower left) is a hybrid experimental car with electric power for the city and a rotary engine for highways. At top right is Toyota's Commuter three-wheeler; at lower right is the Nissan 315-A, both built for two.



Smile for the camera

If you were 140 times smaller—or ants were 140 times larger—this is how one of the little beasts would appear in a face-to-face confrontation. This remarkable portrait was made with a scanning electron microscope at the General Electric Research and Development Center, Schenectady, N.Y. It shows the ant 140 times natural size.



Press box on wheels

Finding it impractical to build a permanent press box, officials of Northwestern High School, Darlington, Pa., built this portable model. They store it behind the stands between games.



Awfully high C

There wasn't much of an audience for this concert by the Falcons, the RAF's parachute team. They played for 60 seconds, opened their chutes and landed in a 30-foot circle.



The running board's back

The Metro-Cab, a new taxicab being tried out by London General Cab Co., has a fiberglass body and a Perkins diesel engine. And for those who miss such things, it has a running board to make access easier.



Bricks from bottles

Bricks are being made from glass bottles by a new process developed by T-A Materials, Palisades Park, N.J. Ground-up glass is mixed with cement, treated in a chemical bath, then pressed in a high-compression mold. Bricks air-cure in a couple of days.



Undersea research sub

Two divers can descend to a depth of 100 feet in a new 10½-foot-long submarine built by Kawasaki Heavy Industries, Japan. The craft has a speed of two knots. An unusual feature is a set of rollers on its bottom which enable it to crawl along the ocean floor.

Coming: A Computerized Collision-Avoidance System

With jumbo jets flying, a single mid-air collision could take a thousand lives. Two amazing cockpit instrument systems are vying for the chance to prevent disasters

By MORT SCHULTZ

BY THE END of the decade, there could be as many as 10 mid-air collisions per year involving commercial airliners, and the number could soar to between 30 and 40 per year by 1985. So warns the Air Traffic Advisory Committee of the Department of Transportation.

A recent study by the National Transportation Safety Board foresees the

toll of future collisions. Because of a sharp increase in the number of aircraft and the advent of jumbo jets, "it is conceivable that in the near future a single mid-air collision could result in the loss of a thousand lives," it states.

What's being done to avert disaster?

The most reassuring step as far as airline passengers are concerned is a black-box system that will automatic-

COLLISION-AVOIDANCE SYSTEM cockpit instrument (Bendix) shows traffic situation, gives vertical escape maneuver commands. When aircraft is descending or climbing and is hazard to another (1), instrument advises the pilot to fly level. If an aircraft is below (2), the pilot is warned. If collision is possible (3), the pilot is told to prepare to climb. If on a collision course (4), pilot is immediately told to climb



ally warn a pilot when collision with another aircraft is imminent and indicate what he must do to avoid it.

According to the Air Transport Assn., which represents virtually all scheduled airlines in the United States, commercial aircraft could begin receiving this collision-avoidance system (called CAS) sometime next year. The cost of equipping an aircraft will be about \$40,000. Thus, cost of installing the CAS in existing aircraft will be approximately \$12 million.

The new CAS system is a time-frequency setup that allots a time slot of 1500 microseconds for each plane, in turn, to transmit important data to other planes in its vicinity. The system can accommodate and sample 2000 aircraft in just three seconds.

Calculations are made by a computer that will be installed aboard each airliner to determine if aircraft are on a collision course. If they are, pilots are issued both an audio and visual signal by an instrument that tells them how to avoid a collision—climb, dive, or fly level.

The airborne CAS will supplement air-traffic-control (ATC) equipment. As matters now stand, the ability of ground-based equipment to keep planes off a collision course is in question. Last September, for example, when an Allegheny Airlines DC-9 and a single-engine lightplane collided over Indianapolis with a loss of 83 lives, the radar controller said that the small plane just didn't show up on his scope although the weather was clear.

This tended to confirm what had been known about ATC radar for some time—that it is not always able to provide adequate signals in precipitation, including periods when the weather is clear but the humidity is high.

In all, there were 303 mid-air collisions from 1956 to 1969, resulting in 989 deaths. Airliners were involved in 24. Fifteen of these were between an airliner and a general-aviation aircraft.

General aviation is a designation that takes in all aircraft which aren't com-



MODIFIED vertical speed indicator, CAS cockpit display by McDonnell Douglas, orders one plane (above) to climb; other, to dive. Each pilot limits the rate of climb or descent so that the pointer does not reach lighted area



mercial of military, and includes privately owned planes, business aircraft, air taxis and trainers.

According to William G. Osmun of ATA, the first objective is to get time-frequency into airliners.

"Our immediate concern is to keep the big guys away from the big guys," he says.

CAS equipment to keep the little guys away from other little guys and from the big guys is currently too expensive. A mini version of the system would cost an owner of a general-aviation plane about \$4000. It's inconceivable that most small-plane owners would spend this unless forced to do so by the government, and that doesn't appear likely at present. This means that those planes most frequently involved in mid-air collisions—general aviation aircraft—would not have a collision-avoidance system.

This is a major objection that one critic of time-frequency offers. That critic is RCA, which is being represented in this controversy by staff engineer Jack Breckman.

Breckman is the main designer of a

type of anticollision system called SECANT which, like radar, sends out probing signals to interrogate the environment. If it passes its tests, SECANT could be available to general and commercial aircraft by 1974.

"SECANT would cost owners of general aviation aircraft anywhere from \$500 to \$1000, depending on how sophisticated the owner wants the system to be," Breckman says. "It would cost the airlines about \$6 million to install the system in all existing aircraft."

"And it's more accurate and reliable than time-frequency," he declares.

In what way? To understand what Breckman means, you first must have some idea of how time-frequency and SECANT differ.

Let's take time-frequency first. During that 1500-microsecond period mentioned above, a plane transmits digital data of its altitude. Range and range-rate are derived from this transmission by the other plane since the signal travels at a known time and frequency.

Range is the distance between two (or more) aircraft. It's determined by the length of time it takes the signal sent by one aircraft to reach the other. For example, knowing that a signal travels at 6 microseconds per mile, if it takes your signal 36 microseconds to be received by my aircraft, it means you're six miles from me.

Range-rate is the rate at which this range is changing. It's obtained by the Doppler shift in electromagnetic frequency as one aircraft approaches another. Simply put, each plane using time-frequency is transmitting at a

known frequency. As aircraft approach each other, it changes pitch.

It's like what happens when a train blowing its whistle approaches you. The Doppler shift in pitch of the whistle is a measure of the speed at which the train is coming toward you.

Time until possible collision, called "Tau", is determined by the formula—

$$\frac{\text{Range}}{\text{Range-Rate}} = \frac{\text{Miles} \times 3600 \text{ (i.e. 36 microseconds)}}{\text{MPH}} = X \text{ seconds}$$

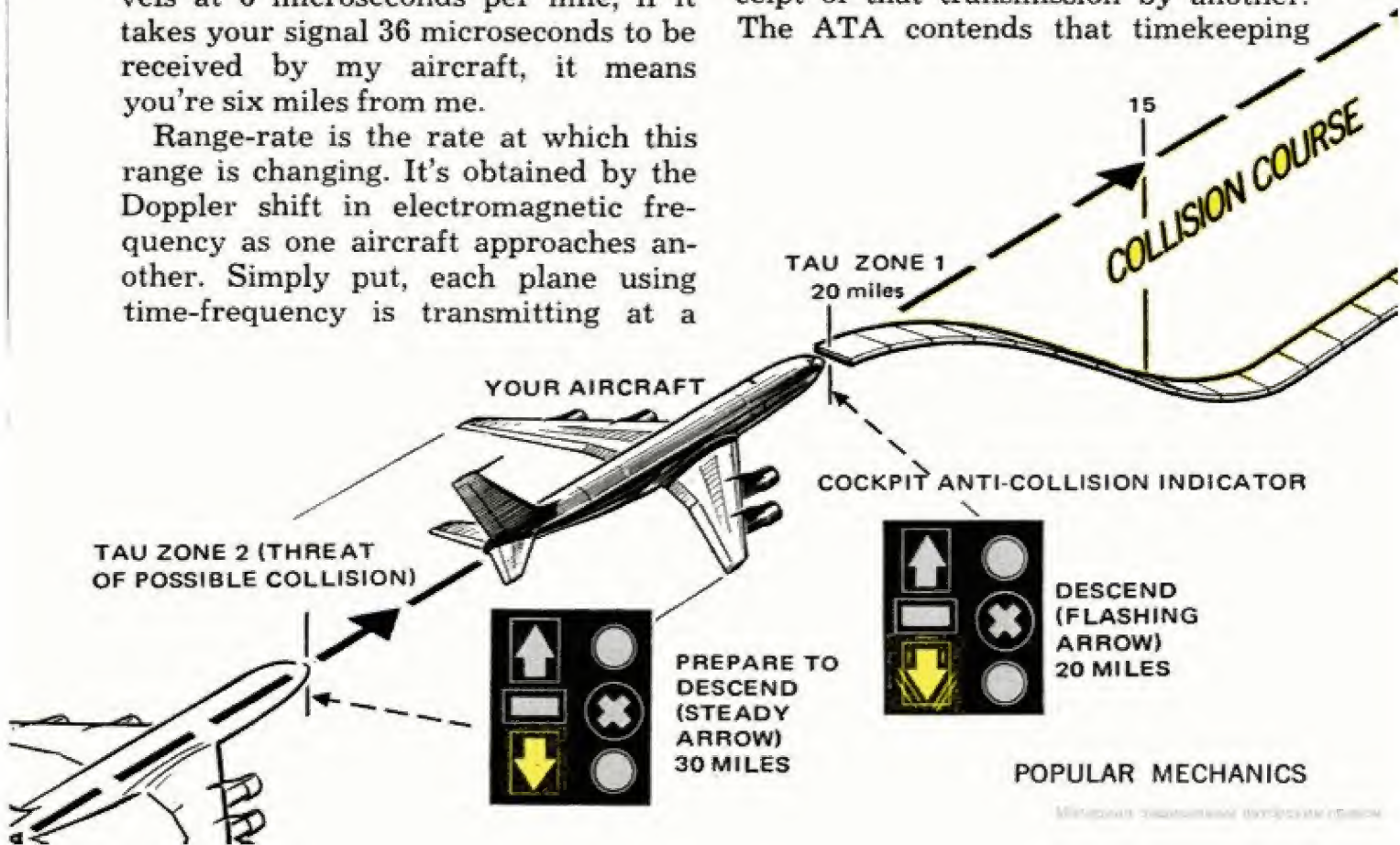
For instance, suppose the range is 6 miles and the range-rate is 400 mph. Tau would be 54 seconds.

$$\frac{6}{400} = \frac{6 \times 3600}{400} = 54 \text{ seconds}$$

At 30 seconds, collision is confirmed or denied. It's confirmed if the protective umbrella of space around the aircraft has been violated. This umbrella allows for 700 feet of unviolated air during level flight and 3500 feet during takeoff and landing.

Once collision is confirmed, the instruments in the cockpit of both planes warn pilots and tell them what to do.

The success of time-frequency depends on accurate timekeeping, since the system relies on measurement of time differences from the start of a transmission by one aircraft to the receipt of that transmission by another. The ATA contends that timekeeping



TIME-FREQUENCY TYPE COLLISION-AVOIDANCE SYSTEM (CAS)

How time-frequency works when two aircraft are headed on a collision course is shown below. While this is a head-on example, the same computations and cockpit warnings apply in other hazardous situations. When a plane penetrates the Tau Zone 2 (Tau: time until collision), the instrument shows a steady red arrow indicating Prepare to Descend or Prepare to Climb. In Tau Zone 1, the arrow will flash red, which is the command to Descend or Climb

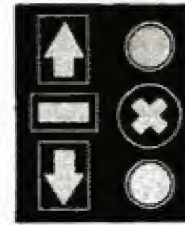
COCKPIT ANTI-COLLISION INDICATOR



CLIMB
(FLASHING
ARROW)
20 MILES

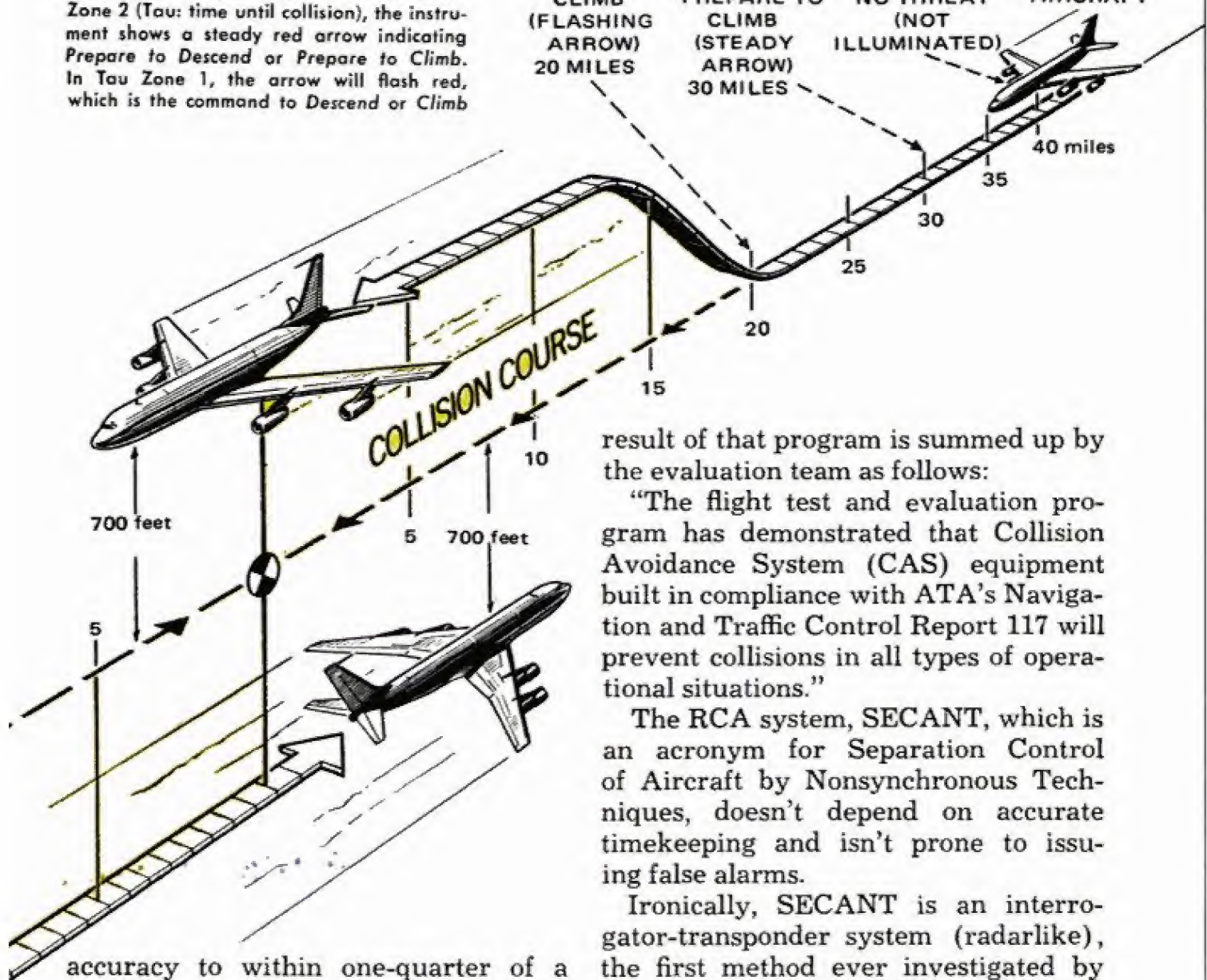


PREPARE TO
CLIMB
(STEADY
ARROW)
30 MILES



NO THREAT
(NOT
ILLUMINATED)

INTRUDER
AIRCRAFT



accuracy to within one-quarter of a millionth of a second can be maintained by atomic clocks.

Breckman says it can't be. He also argues that data signals around an airport, where hundreds of planes could be stacked up at a time, would by flying so fast and furious that there would be no way of avoiding false alarms.

"The hardware works," Osmun reports.

This seems to be confirmed by a flight test and evaluation program of time-frequency equipment that was completed by the Martin Marietta Co. as this article was being prepared. The

result of that program is summed up by the evaluation team as follows:

"The flight test and evaluation program has demonstrated that Collision Avoidance System (CAS) equipment built in compliance with ATA's Navigation and Traffic Control Report 117 will prevent collisions in all types of operational situations."

The RCA system, SECANT, which is an acronym for Separation Control of Aircraft by Nonsynchronous Techniques, doesn't depend on accurate timekeeping and isn't prone to issuing false alarms.

Ironically, SECANT is an interrogator-transponder system (radarlike), the first method ever investigated by the ATA in its search for an anticollision system. It was dismissed as impractical back in 1955 because of the "fruit" problem.

Fruit results when more than two aircraft in an area are probing and transmitting at the same time. Only the signals of the plane that is on a collision course with your plane is of importance. However, you receive the signals of other planes, too. That's fruit, and up to now no one has been able to develop an interrogator-transponder system that could weed out the fruit and

(Please turn to page 198)

You Can Make This MODEL STEAM TRACTOR

Built to a three-quarter-inch scale and patterned after the famous J. I. Case threshing-machine tractor, this modelmaker's beauty actually runs

By RUDY KOUHOPT

Color Photo by Robert D. Borst

IF MODELMAKING is your cup of tea, you won't want to wait to start this museum masterpiece which represents a page out of history.

Big on American farms at harvest time more than a half century ago, the steam-traction tractor with its familiar canopy top was an exciting, self-propelled, hissing, smoke-belching monster which traveled from farm to farm to drive a stationary threshing machine by belt and pulley. You'll find it just as exciting in model form when under its own head of steam.

Though remarkably akin to the well-known Case farm tractor which roamed farmlands at the turn of the century,

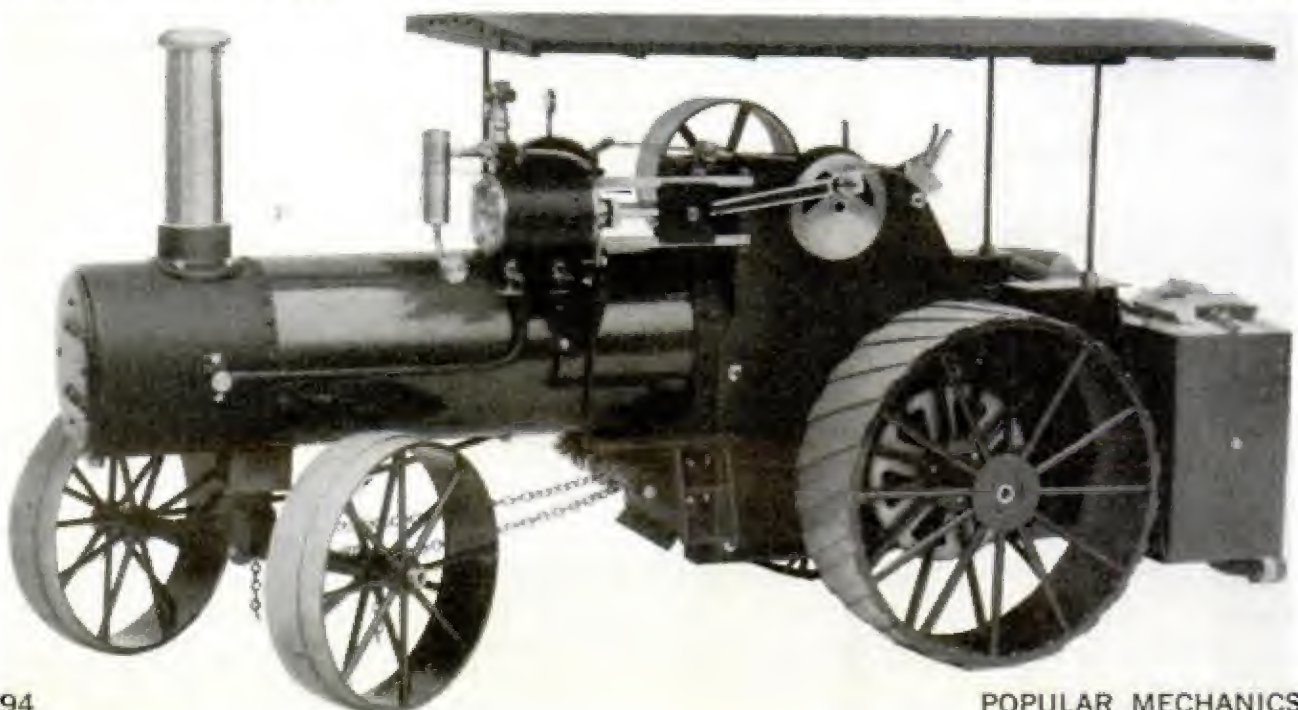
my model is not an exact scale replica. To simplify construction, I rearranged some of the parts to insure dependable operation.

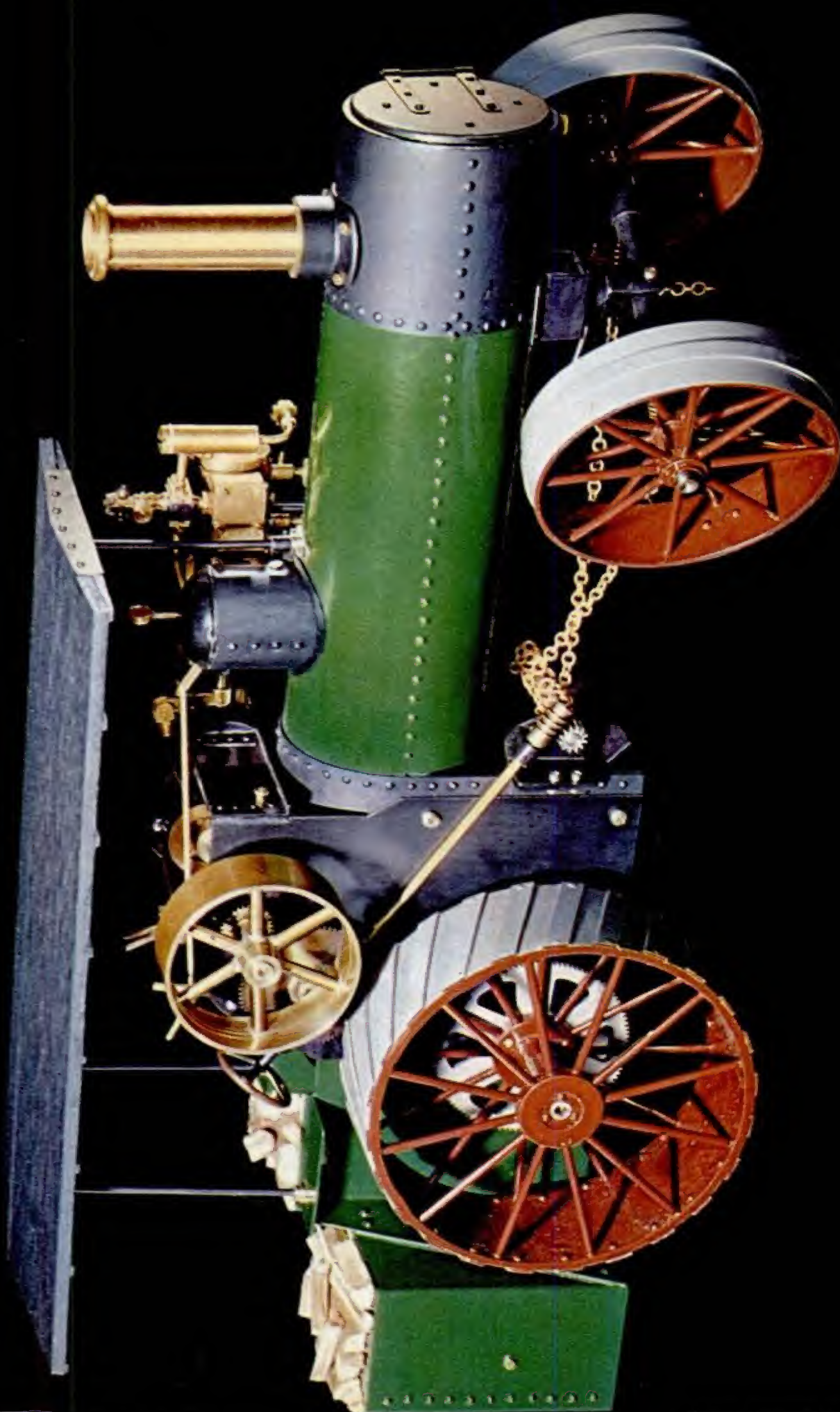
While limited editorial space prohibits detailing this beautiful model in the magazine, complete step-by-step directions and a set of full-scale plans are available. See page 96.

The framework. Most steam-traction tractors did not have a separate framework or chassis. Instead, they relied upon the shell of the boiler to serve as sort of external frame to which the cylinder, front axle, smokestack and other parts were attached by rivets or bolts. I found that a short length of

CONT'D P9-136

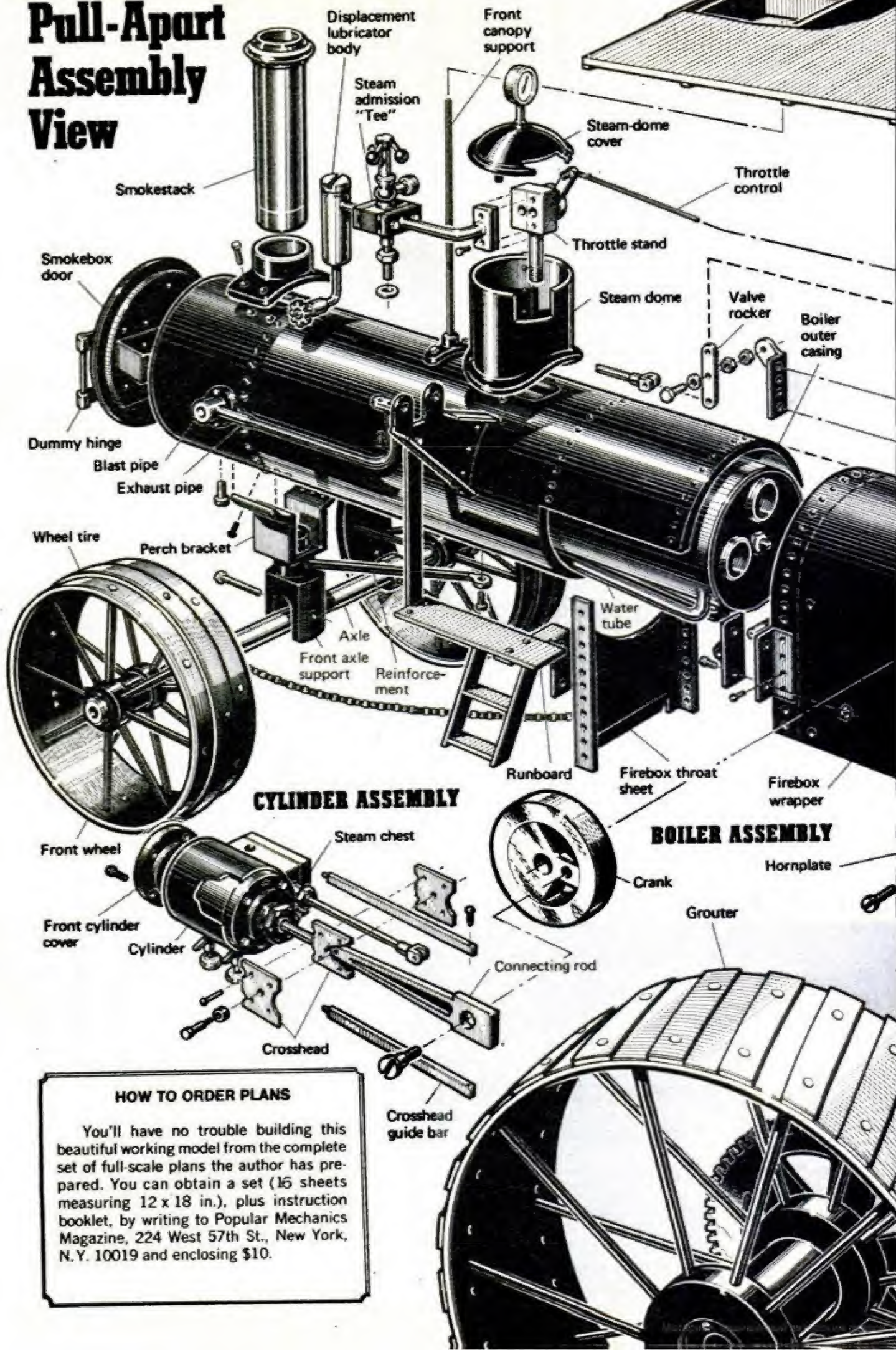
IT'S EXCITING JUST TO LOOK AT, and more so when you see it hissing and puffing under its own power





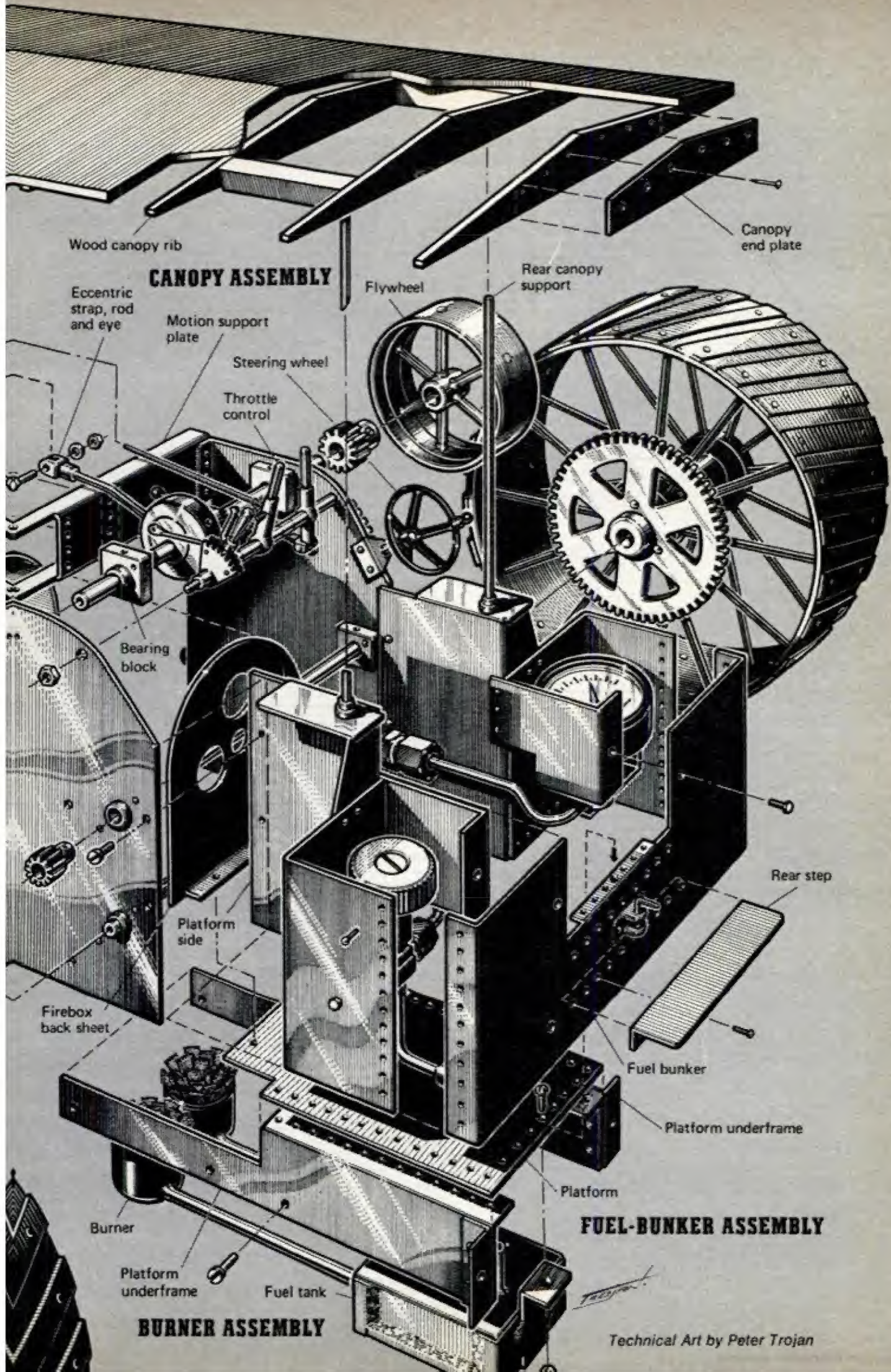
Материал: Ламинированный пластик с краской

Pull-Apart Assembly View



HOW TO ORDER PLANS

You'll have no trouble building this beautiful working model from the complete set of full-scale plans the author has prepared. You can obtain a set (16 sheets measuring 12 x 18 in.), plus instruction booklet, by writing to Popular Mechanics Magazine, 224 West 57th St., New York, N.Y. 10019 and enclosing \$10.



CANOPY ASSEMBLY

FUEL-BUNKER ASSEMBLY

BURNER ASSEMBLY

Technical Art by Peter Trojan

AUTOMOTIVE



Jeep Gladiator



Ford Ranchero

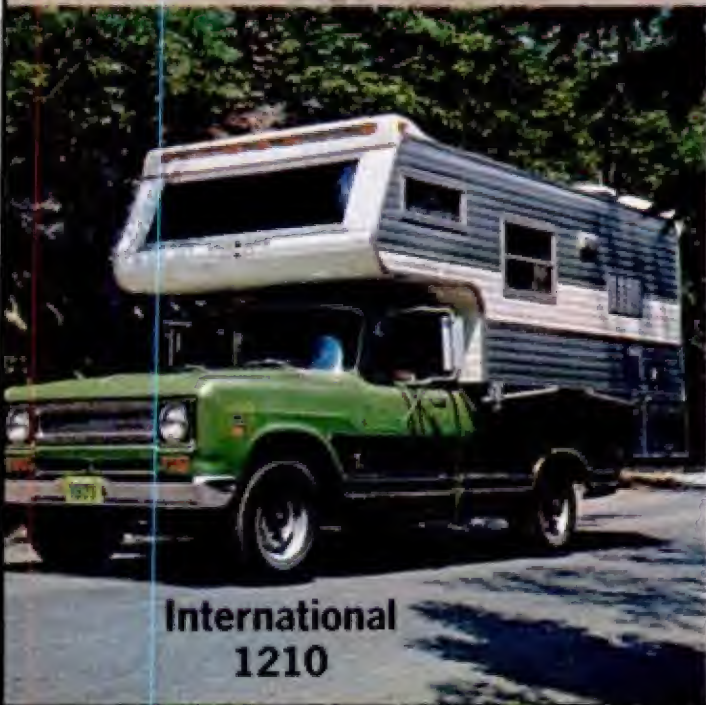
The '71s: Pickups



Chevrolet Cheyenne 10



**GMC
Sierra Grande
2500**



**International
1210**

Every year the all-purpose pickups get classier, more comfortable and more suited to serve as both workhorse and recreational vehicle.

By **MICHAEL LAMM**
West Coast Auto Editor

EACH YEAR, pickups become a little more like cars. Ford's Ranchero and Chevy's El Camino are obvious examples, but even the ones that still look like pickups now feel, ride, sound, handle and pamper you almost the way cars do—in some cases even like luxury cars.

Today, pickups are called on to perform every task cars do, *plus*: become a camper on the weekend after hauling hay all week after taking the missus to the store every night after helping dad move the neighbor's furniture after towing the boat home from the lake after delivering a load of shingles to the summer cabin—and so on, ad infinitum. There's no end to the pickup's versatility.

You're as likely to see a housewife behind the wheel of a new pickup as you are a businessman. That's because airconditioning, power steering, power disc brakes, automatic transmission,

That Pamper



Dodge 100

bucket seats, console, vinyl roof, stereo and hosts of other refinements go into pickups today on a regular basis. A "loaded" pickup no longer means in the cargo bed. Today it's in the cab and under the hood.

Nearly all manufacturers offer jazzy top-of-the-liners that turn heads and influence buying decisions . . . in big-town showrooms, not just out in the country. Dodge offers the Adventurer and Dude, Ford the Ranger XLT, Chevy the CST, International a Custom series, and GMC the Sierra. But, of course, you can still get a good, basic, not-too-expensive workhorse, the lowest-priced half-tonners beginning around \$2500 base. Three-quarter-ton models begin about \$2700; one-ton pickups around \$2900 stripped. You can easily work your way above \$4000, though, and that *excludes* the camper. Two economical alternatives to full-size pickups are the Datsun and Toyota pickups—both in the half-ton range.

These "ton" designations now mean relatively little. They used to refer to payload; that is, a one-ton pickup used to be able to carry a maximum payload of 2000 pounds in its bed. Now a full one-tonner most often carries two tons with ease—with heavy-duty suspension, even more. Tires and other components have been upgraded, with manufacturers recommending specifics for various loads.

Each line and series of pickups offers several styles and sizes of boxes. Styles are either slab-sided or have outjutting fenders. There's more total room in slab-sided models, but they cost more and sometimes space is chopped up.

Matching your needs to a specific pickup might take some long, hard thought. Despite appearances, there's a lot more to a pickup than to a car—factors and features that tailor them to individual jobs. Lists of noncomfort options alone are staggering. You have to get deeply involved in such things as weights, spring rates, capacities, load shapes, tire ratings, axle and transmission ratios, wheelbases and height. So

when you buy a pickup, especially your first, take it easy. Study the entire field — all makes and models. They're hard to compare, because all makers use slightly different standards. Our chart will dispel some of the confusion.

Pickup sales have soared these last few years. The rise began when campers started to become popular. Last year, Detroit sold over 1.5-million pickups—one for every five cars. Ford alone sold more pickups than all Mavericks, Mustangs, Thunderbirds and Falcons put together. During the first six months of 1970, Chevy led Ford slightly in total light-truck sales, followed respectively by Dodge, International, GMC and Jeep.

JEEP GLADIATOR

As you probably know, Kaiser Jeep Corp. recently merged with American Motors Corp. This means there are bound to be changes in the Gladiator, although there have been few formal announcements. Actually, it's been Jeep's policy *not* to make annual model changes, but to incorporate running improvements when necessary. This policy will continue, but coincidentally some of the Gladiator's most important changes will happen just in time for 1971. (All Jeep vehicles built during calendar 1970 are called 1970 models; those built during calendar 1971 will be 1971 models, and so forth.)

Gladiators have long used AMC's 232-c.i.d. 6-cylinder engine and will keep it as *the* base powerplant. AMC's new-for-1971 258-c.i.d. Six will likely be optional. But Buick's 350-inch V8 will no longer be offered, and in its place the Gladiator will use AMC's 360-inch V8 at 245 bhp after Jan. 1. Another change will be to swap the optional Turbo Hydra-Matic for AMC's automatic.

Jeep Gladiators are the only U.S. pickups that have four-wheel drive as standard. This gives them the highest base prices in their class, but it also makes them at home in the roughest

country. Snow, mud and the end of the road hardly faze a Gladiator. All Jeeps share a reputation for ruggedness.

All luxury and convenience options are available for the Gladiator. You can also order power takeoff, a dumper body, snowplow, wrecker package and front-mounted winch. A special camper package has a payload capacity of 3930 pounds, extra-heavy-duty suspension, four-speed all-synchro trans, H-D cooling and 10-ply tires.

INTERNATIONAL

International pickups offer more wheelbases and different transmissions

than any other. Basic engine, as in the Gladiator, is AMC's 232-c.i.d. Six. There are four V8s in addition, plus three, four, and five-speed manual gearboxes (even a five-speed with top gear being overdrive); also an automatic on either two or four-wheel-drive models.

The 1010 and 1110 series, rated as half-tonners, are virtually identical except for differences in front suspension. The 1010 uses independent torsion-bar front suspension; the 1110 and all bigger International pickups, I-beam solid axles up front.

All I-H series above the 1010 can be

(Please turn to page 188)

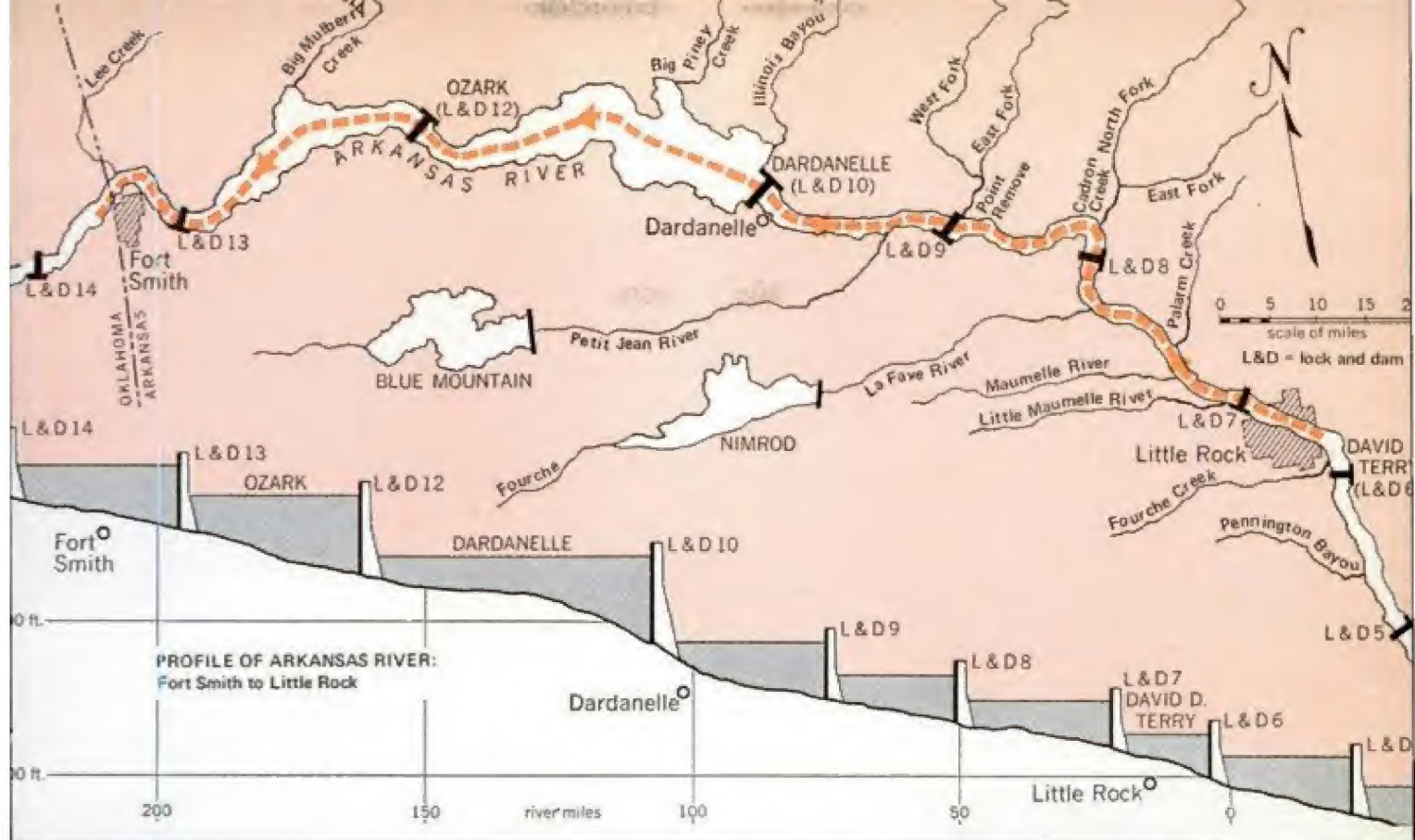
SPECIFICATIONS OF THE 1971 PICKUPS

| Make Model | Ton | Std. Suspension | | H-D Suspension | | WB. (in.) | Lgth. (in.) | Box Size (cu. ft.) | Engine* | Bhp @ rpm | Torque @ rpm | Avail. Trans.* | |
|------------------------------------|------------|--------------------|----------------|----------------|----------------|-----------|-------------|--------------------|---------|------------|--------------|----------------|---------|
| | | GVW (lbs.) | Payload (lbs.) | GVW (lbs.) | Payload (lbs.) | | | | | | | | |
| CHEVROLET El Camino CS/CE-10 | 1/2 | 4100 | n.a. | n.a. | n.a. | 116 | 201.2 | n.a. | 6-250 | 145 @ 4200 | 230 @ 1600 | 3-man. | |
| | 1/2 | 4400 | 1230 | 5000 | 1400 | 115 | 188.5 | 58.4 | 6-292 | 165 @ 4000 | 270 @ 1600 | 4-man. | |
| | | | | | | 127 | 207.8 | | 6-292 | 170 @ 4000 | 270 @ 1600 | 2-auto. | |
| CS/CE-20 | 3/4 | 6200 | 3500 | 7500 | n.a. | 127 | 207.8 | 74.3 | V8-307 | 200 @ 4600 | 300 @ 2400 | 3-auto. | |
| | | | | | | 133 | 213.8 | | V8-307 | 215 @ 4000 | 300 @ 2400 | | |
| CS/CE-30 | 1 | 6600 | 3700 | 14000 | n.a. | 133 | 213.8 | 82.5 | V8-350 | 215 @ 4000 | n.a. | | |
| | | | | | | | | | V8-350 | 245 @ 4800 | 350 @ 3000 | | |
| | | | | | | | | | V8-350 | 250 @ 4600 | 350 @ 3000 | | |
| | | | | | | | | | V8-350 | 270 @ 4800 | 375 @ 2800 | | |
| | | | | | | | | | V8-400 | 300 @ 4800 | 400 @ 2400 | | |
| | | | | | | | | | V8-454 | 365 @ 4800 | 500 @ 3200 | | |
| DODGE D-100 | 1/2 | 5200 | 1600 | 5200 | n.a. | 114 | 188.1 | 75.0 | 6-225 | 145 @ 4000 | 215 @ 2400 | 3-man. | |
| | | | | | | 128 | 208.8 | | V8-318 | 212 @ 4000 | 322 @ 2800 | 3-auto. | |
| | D-200 | 3/4 | 7500 | 2500 | 7500 | n.a. | 128 | 208.8 | 75.0 | V8-383 | 258 @ n.a. | 375 @ n.a. | 4-man. |
| D-300 | 1 | 8000 | 3750 | 8000 | n.a. | 160 | 208.8 | | | | | | |
| | | | | | | 133 | 218.6 | 66.0 | | | | | |
| | | | | | | 159 | | | | | | | |
| FORD Ranchero F-100 | 1/2 | 4000 | 850 | 4950 | 1250 | 114 | 209.0 | 39.1 | 6-240 | 150 @ 4000 | 234 @ 2200 | 3-man. | |
| | | | | | | 115 | 187.8 | 82.3 | 6-250 | 155 @ 4000 | 240 @ 1600 | 3-auto. | |
| | 1/2 | 4200 | 1250 | 5600 | 1650 | 131 | 205.4 | | 6-300 | 165 @ 3600 | 294 @ 2000 | 4-man. | |
| | | | | | | 131 | 205.4 | 82.3 | V8-302 | 220 @ 4600 | 300 @ 2600 | 3-o.d. | |
| | F-250 | 3/4 | 6100 | 1950 | 7700 | 3500 | 135 | 217.4 | 82.3 | V8-351 | 250 @ 4600 | 355 @ 2600 | |
| | F-350 | 1 | 6600 | 2400 | 10000 | 6060 | 135 | 217.4 | 82.3 | V8-351 | 300 @ 5400 | 380 @ 3400 | |
| | | | | | | | | | V8-351 | 300 @ 5400 | 380 @ 3400 | | |
| | | | | | | | | | V8-360 | 215 @ 4400 | 327 @ 2600 | | |
| | | | | | | 159 | 237.2 | | V8-390 | 255 @ 4400 | 376 @ 2600 | | |
| | | | | | | | | | V8-429 | 370 @ 3400 | 450 @ 3400 | | |
| GMC CS/CE-1500 | 1/2 | 4400 | | 5400 | | 115 | 188.5 | 58.4 | 6-250 | 145 @ 4200 | 230 @ 1600 | 3-man. | |
| | | | | | | 127 | 207.8 | | 6-292 | 165 @ 4000 | 270 @ 1600 | 4-man. | |
| | CS/CE-2500 | 3/4 | 6200 | | 7500 | | 127 | 207.8 | 74.3 | V8-307 | 200 @ 4600 | 300 @ 2400 | 2-auto. |
| CS/CE-3500 | 1 | 6600 | | 1400 | | 133 | 213.8 | | V8-350 | 250 @ 4600 | 350 @ 3000 | 3-auto. | |
| | | | | | | 133 | 213.8 | 82.5 | V8-400 | 300 @ 4800 | 400 @ 3200 | | |
| INTERNATIONAL 1010, 1110 | 1/2 | 4800 | 1600 | 5400 | 2200 | 115 | 184.0 | 66.0 | 6-232 | 145 @ 3200 | 215 @ 1600 | 3-man. | |
| | | | | | | 119 | to | | V8-266 | 155 @ 4400 | 227 @ 2800 | 3-auto. | |
| | 1210 | 3/4 | 6100 | 3700 | 7500 | n.a. | 131 | 202.0 | | V8-304 | 193 @ 4400 | 272 @ 2800 | 4-man. |
| 115 | | | | | | | 184.0 | 66.0 | V8-345 | 197 @ 4000 | 309 @ 2200 | 5-man. | |
| | | | | | | 119 | to | | V8-392 | 236 @ 4000 | 354 @ 2600 | 5-o.d. | |
| | | | | | | 131 | 235.0 | | | | | | |
| | | | | | | 149 | | | | | | | |
| | | | | | | 164 | | | | | | | |
| 1310 | 1 | 7000 to 8000 | 3900 | 10000 | 5925 | 134 | 214.0 | 66.0 | | | | | |
| | | | | | | 149 | to | | | | | | |
| | | | | | | 156 | 244.0 | | | | | | |
| JEEP J-2000 J-4000 | 1/2 | 5000 | 1462 | n.a. | n.a. | 120 | 189.0 | 38.6 | 6-232 | 145 @ 3200 | 215 @ 1600 | 3-man. | |
| | | | | | | 132 | 206.0 | 44.4 | 6-258 | 160 @ 4000 | 245 @ 1600 | 3-auto. | |
| | 3/4-1 | 5000 | 1305 | 8000 | 3633 | 132 | 206.0 | 44.4 | V8-360 | 245 @ 4400 | 365 @ 2400 | 4-man. | |

*Not all engines and all transmissions available in all models

BOATING





Honeymoon On a Houseboat

PM's Boating Editor and his bride explore
America's newest waterway.

By GEORGE REIGER

ARKANSAS IS BOOMING! And much of the boom is in the dynamite used in the greatest waterway project since the Panama Canal was built. In fact, damming and diking the Arkansas River has been a *bigger* job than the dredging of that Latin-American ditch—and far more expensive. If \$1.2 billion is hard to comprehend, consider instead that enough stone has been dropped between Fort Smith and the Mississippi River to build a 77-story pyramid covering 19 city blocks

and enough pilings driven to reach from Little Rock to Washington, D.C.!

This pile-driving and rock-dumping has provided a dependable commercial waterway between Oklahoma (particularly Tulsa's port of Catoosa) and the Gulf States, and then abroad. Grain, coal, cattle and bauxite will go downstream while the goods of the world flow up. It is anticipated that eventually 13.5 million tons of cargo will be shipped annually over this route.

Hydroelectric power, water supply and recreation are additional benefits. Recreation will boost another of the area's "booms." Not that the state's boating industry needs it—Arkansas is already No. 1 in total boat production, from lazy johns to sleek cruisers

1) LOOK MA, ONE HAND! Barbara demonstrates houseboat's ease of handling. 2) Hot coffee underway. 3) Pair of fresh-caught bass the girls quickly converted to lunch. 4) Running beneath wooded bluffs of Big Piney Creek. 5) Jack pulls trap for Carolyn while Barbara cheers on the girls' team



TUMBLING TORRENTS below dams are in striking contrast to the quiet rise of water in the locks

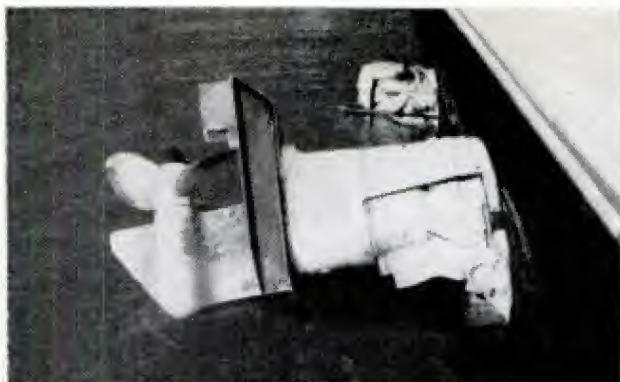


BEDMAKING and dishwashing are done in spaces slightly smaller than those in our city apartment



Ten Tips For Locking Through

- Approach at reduced speed, staying between red and black channel buoys.
- Boats carrying a whistle or horn should signal one long blast (3 to 10 seconds) at a distance not exceeding one-half mile.
- Small craft without whistles or horns should use the manual signal chains located at each end of the lock.
- Wait for lockman to signal entry; either a blinking green light or one long blast on an air horn.
- Boats going downstream should stay at least 400 feet upstream from the end of lock wall until entry signal is received. Larger craft may be about to leave the lock heading in your direction.
- Carry at least 50 feet of mooring line.
- Dock at floating mooring bits only; do not tie to ladders or mooring posts.
- Use fenders to spare hull and lock walls.
- Don't leave your engine on during lockage; no smoking or open flames allowed.
- Remember your priority (pleasure boat) is fifth after U.S. government vessels, commercial passenger boats, commercial tow and rafts. Lockmen are like traffic policemen. Obey their instructions.



ONE ADVANTAGE of OMC's stern-drive system is that entire lower unit can be raised out of the water



JACK PRUDENTLY CHECKS oil, fuel supply and other mechanicals each morning before getting underway



WATER PUMP, easily accessible, is neatly hidden from view under cutaway section of carpeted deck



MARINAS ARE FEW between Dardanelle and Fort Smith, so we carried two fuel tanks as "insurance"

and houseboats. Hearing of all this activity, my bride and I decided a trip up the "new" river in Arkansas's latest houseboat would be an exciting way to spend our honeymoon. We weren't disappointed.

Sales Manager Jack Seastrom of Kenner Boats located at Knoxville, half-way up the river, met us in Little Rock and quickly got us settled aboard a handsome Suwanee 35-footer. Making sure we were well provisioned for the first leg of the journey, he bade us farewell and said he'd look us up at Dardanelle.

The run upstream to this major reservoir is an eight-hour effort, but since we wanted to explore and putter along the way, we left well before noon.

Navigating the Arkansas used to turn up shifting channels, sudden shallows and flooding. Today the channel is stable, well marked and averages 9 feet deep and 250 feet wide for its 466-mile length from Catoosa to Rosedale, Miss. Yet minor hazards persist in the many pieces of driftwood (some quite siz-

able). The solid fiberglass construction of the Kenner hull turned aside all the small pieces; it was just the thought of meeting an errant piling drifting off to New Orleans that worried me! When pounding upstream with a pair of 120-hp OMC sterndrives at better than 20 knots, you could make a pretty healthy hole in your hull if you hit just the right snag.


Barbara prepares lunch as we run. Regular meals are a refreshing change from the odd hours of bachelor life. The idea of eating a hot steak at the helm of a speeding boat while Barbara makes the coffee and tidies up the kitchen—and later, when she takes the helm while I rig tackle or read—is hard to imagine in most small boating situations. Our houseboat suffers with rather noisy vibrations at low speeds, but at better than 4000 rpm, our surroundings seem every bit as familiar as our apartment back in the city—with a far more pleasant view!

A note from my diary: "The feeling

(Please turn to page 190)

Surf Fishing With a 4-Wheel Drive

By GEORGE W. LINNANE



With one of these rugged vehicles you can extend your range and increase your catch.

STRIPED-BASS ANGLERS have been doing it since the first Model A was converted to a beach buggy. Nowadays, modern off-the-road four-wheelers make beach driving easy and increasingly popular. And so many mobile anglers use New York and New England beaches that they have organized voluntary associations to regulate themselves.

The three basic categories of four-wheel-drive vehicles are: 1) short wheelbase, highly mobile, on-and-off-the-road, multiuse passenger carriers like the Jeep, Scout, Broncho, Blazer, Toyota Land Cruiser and Land Rover; 2) station wagons, not much different in appearance from their two-wheel-drive counterparts; 3) pickup campers, which mount a living-space camper on a truck pickup body like Jeep's Gladiator and Dodge's Power Wagon.

They're all basically trucks and are sold like trucks. The newcomer may be astonished to find that top, rear seat and even bumpers are

part of a lengthy list of optional extras.

Vehicles in the first category rarely bog down. Their short wheelbase (88 to 104 inches), high clearance and light weight permit them to ride the sand and avoid being trapped. With the tires deflated to 10 or 15 pounds pressure they go just about anywhere. They'll carry four anglers with surf rods mounted on the roof or front bumper. There's little space left over, however, and this is their chief disadvantage. In addition, highway performance is only fair.

Four-wheel-drive wagons are closer to being all-around cars. Their longer wheelbase makes them a bit less nimble on the sand than the Jeep-type vehicles, but they'll carry passengers and baggage with ease. The Jeep Wagoneer has the shortest wheelbase (110 inches). The largest is the Chevrolet Carryall and GMC Suburban with the International Travelall a close second. Interiors may be rigged for sleeping and limited cooking. Highway performance is adequate.

Pickup campers, the third category, look like their two-wheel-drive cousins, but the four-wheel drive transfer case makes them more dependable and versatile on the dunes. The 4x4, 3/4-ton model is the best choice for highway stability and hard pulling in deep sand. It can sleep four and serve as a family camper. When not on the beach, the truck can be driven out from under the camper and put into service for everyday hauling.

All these vehicles are exposed to the corrosive effects of salt air and water. Driving in saltwater is disastrous to metal and should be avoided at all costs. Frequent washings, undercoating and care in selecting a dry trail are musts.

Beach driving is regulated by federal, state and local governmental agencies. Typical regulations are those prescribed by the Cape Cod National Seashore

(Please turn to page 192)

TALK ABOUT FRESH FISH! Advantage of camper fishing is that mere minutes elapse from catch to dinner
FEBRUARY 1971



CAPE COD CAMPER-ANGLERS overlook beach and relax while waiting for the striped bass to show up



SOON AFTER LEAVING BEACH, reinflate your tires to save unnecessary wear driving over paved roads



IT'S EASIER to follow feeding, moving fish in a four wheeler than to run along behind them on foot





Rats are pollution warning

Caged white rats are being used on busy Tokyo streets to check the amount of air pollution caused by passing motor vehicles. If the pollution becomes severe enough, it will kill the rats.



Timber stacker's masterpiece

Stacking lumber so it takes up a minimum of space, remains accessible and still has air circulating around it is an art. John Clark of London, a master of the art, arranged this 4000-ton stack with a passage for trucks.



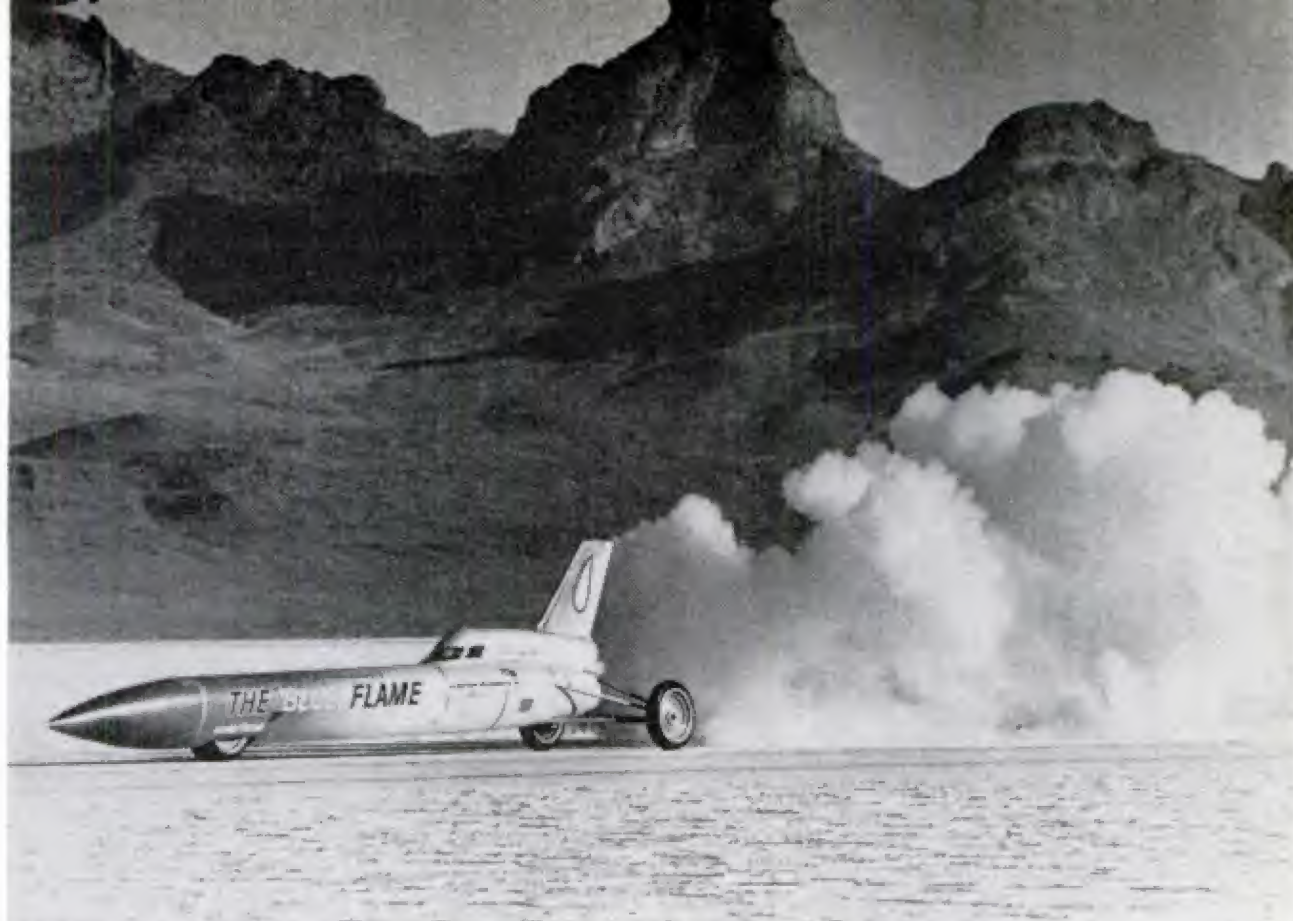
Russian air-cushion vehicle

Shown during a trial run is the new Russian air-cushion vehicle, the Sormovich. The 50-seat vessel, designed and manufactured at the Krasnoye Sormovo Works, can travel at speeds of between 50 and 60 mph.



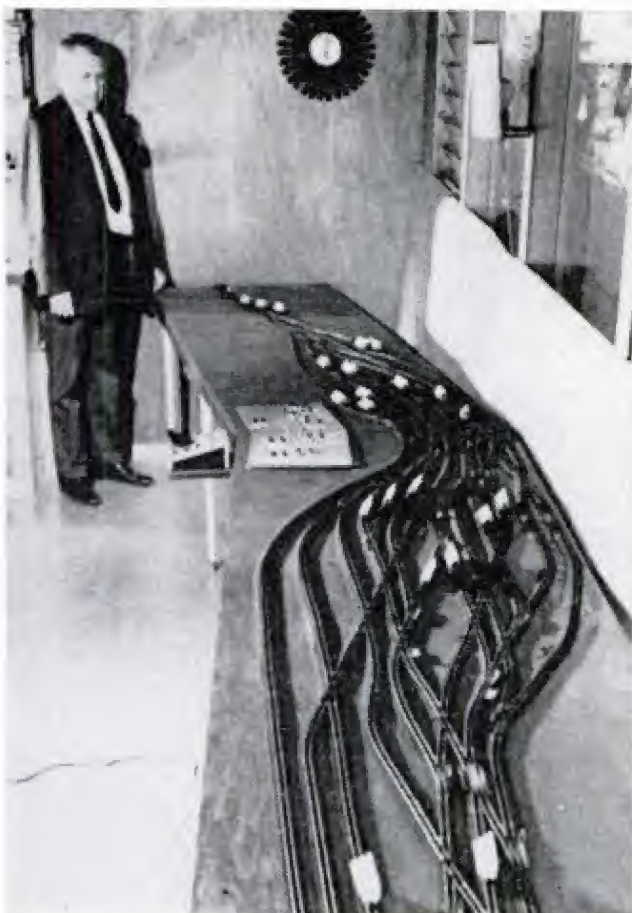
Three-quarter-scale Bugatti

Car buff Geoffrey Sutton, who feels that many people would like to own a Bugatti (as he does), built this three-quarter-scale "Weston Bugatti" at his Lancashire factory where he hopes to turn out about 100 a year. Project engineer Tom Lawrence is shown driving the car in a test run.



Gary Gabelich sets world land record in The Blue Flame

The Blue Flame blasts off at the start of one of its runs when it set a world land speed record of 622.407 mph on Oct. 23. Driven by Gary Gabelich, 30, of Long Beach, Calif., the rocket-propelled vehicle topped the previous land speed record by over 21 mph. (The record had been held since 1965 by Craig Breedlove.) *The Blue Flame*, which is sponsored by the natural gas industry and was built by Reaction Dynamics, Inc., Milwaukee, uses liquefied natural gas and hydrogen peroxide as propellants.



Space station simulator

Space engineers spend up to a week in this giant spinner to provide information for building an Earth-orbiting space station. The spinning of the North American Rockwell unit creates artificial gravity similar to that of a rotating space station.

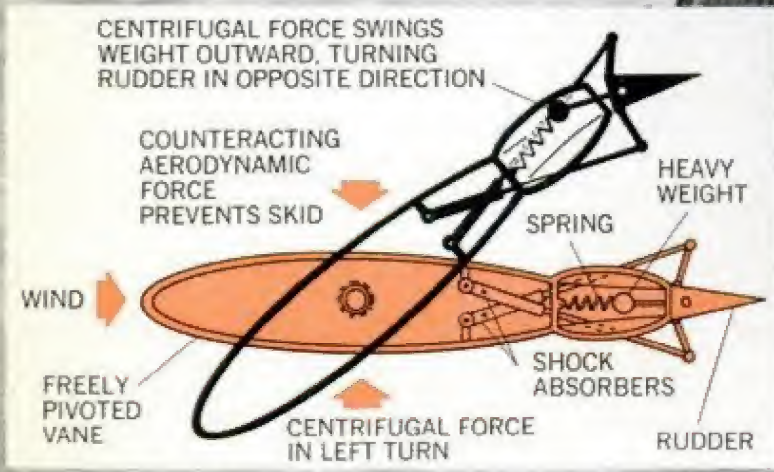
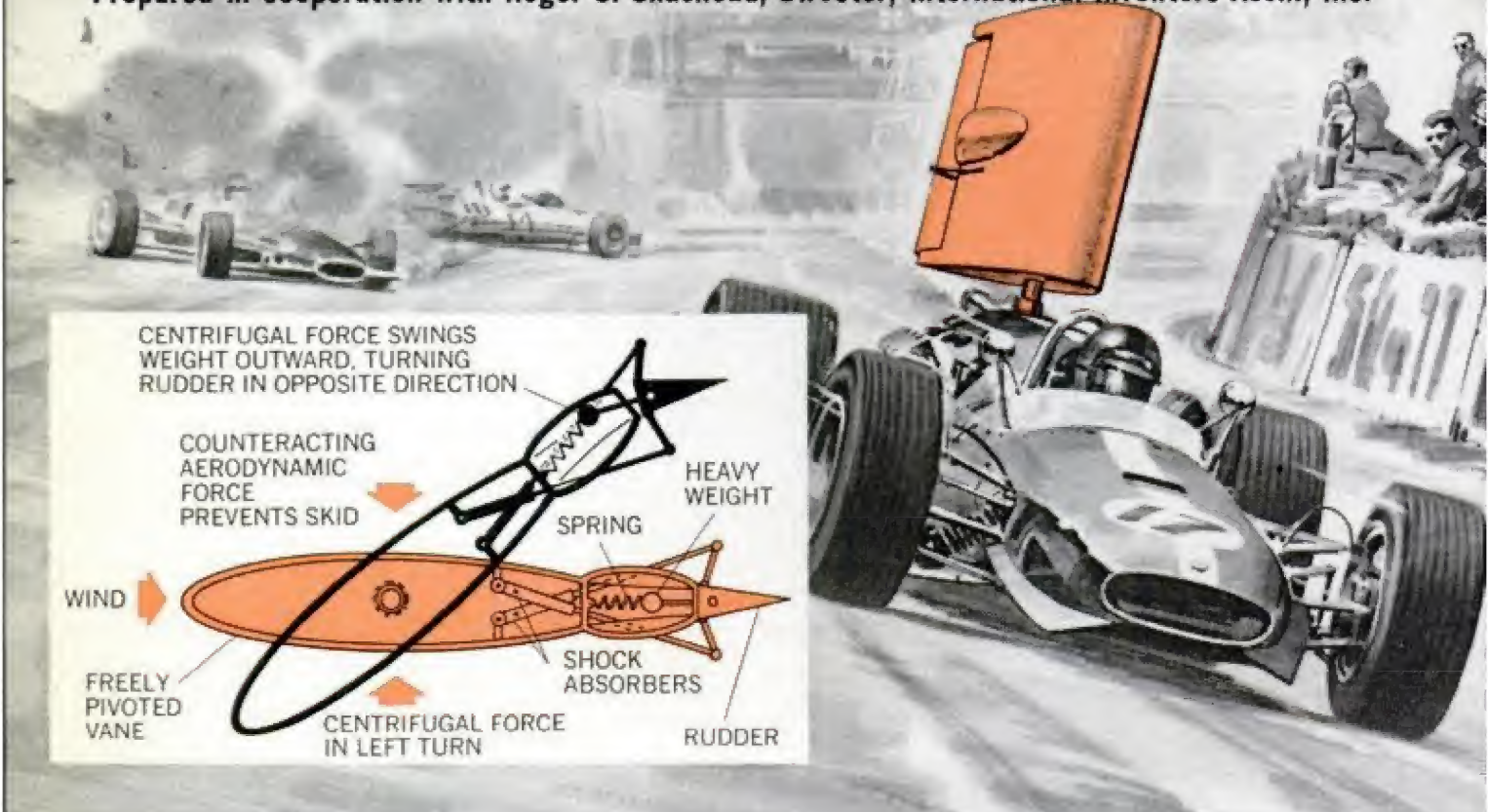
'Train of Thought'

William H. Miller, professor of English at Diablo Valley College, Pleasant Hill, Calif., uses an N-gauge train layout to make the teaching of English sentence structure more graphic—and more fun for elementary pupils. Pupils push buttons to select various options; the programmed locomotive then picks up words in the correct order and form. Prof. Miller calls it the "Train of Thought."

Just patented

PM'S PICK OF THE NEW INVENTIONS

Prepared in cooperation with Roger S. Shashoua, Director, International Inventors Assn., Inc.

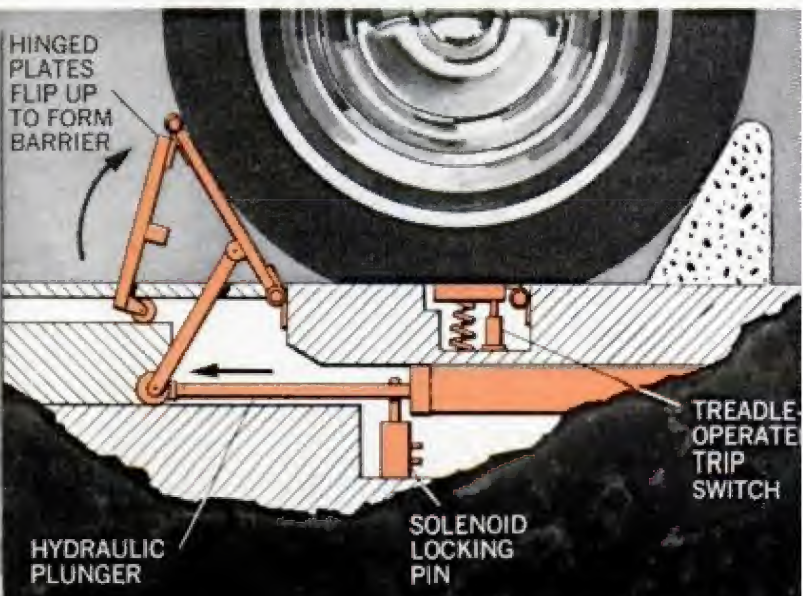


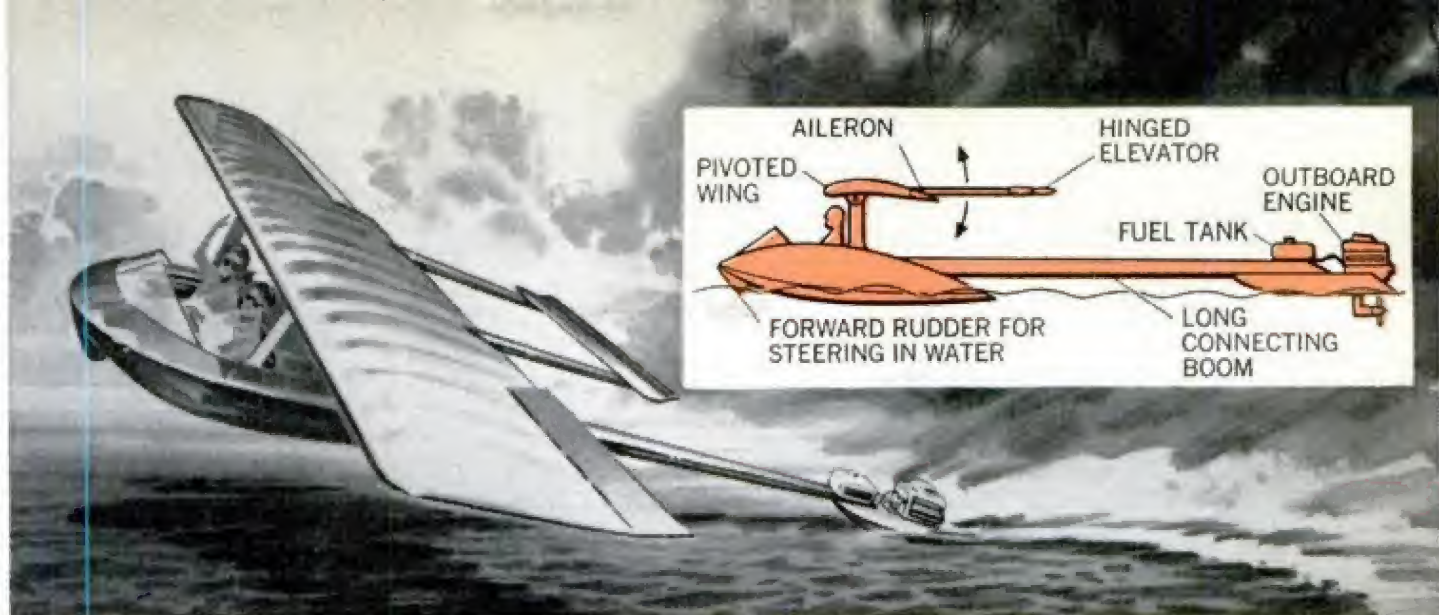
1. FASTER TURNS FOR RACING CARS are the object of this sail-like antiskid device. Unlike steerable fins, it is free to pivot like a weathervane. On a straightaway, it automatically lines up with the relative wind, eliminating drag, even in a direct crosswind. A small rudder vane at the trailing edge is controlled by a counterweight. On a turn,

centrifugal force throws the weight outward, turning the rudder inward. This forces the main fin to bite into the wind, putting air pressure on its outer face—the side away from the turn. The outer force keeps pushing the car into the turn to counteract a skid. By contrast, the steerable fins do not allow for prevailing wind and frequently cause drag

2. YOU HAVE TO PAY this parking meter or you can't take your car. As you pull in, your wheels strike a treadle switch, actuating a hydraulic mechanism that flips up a hinged barrier behind the wheels to lock the car in place. When you're ready to leave, the meter shows the time expired and the

amount you owe. When you deposit the correct coins, the barrier retracts and you're free to go. This prevents motorists from sneaking in and parking free at meters with unexpired time on them. However, you can park as long as you like without getting a ticket since you simply pay for the time you use

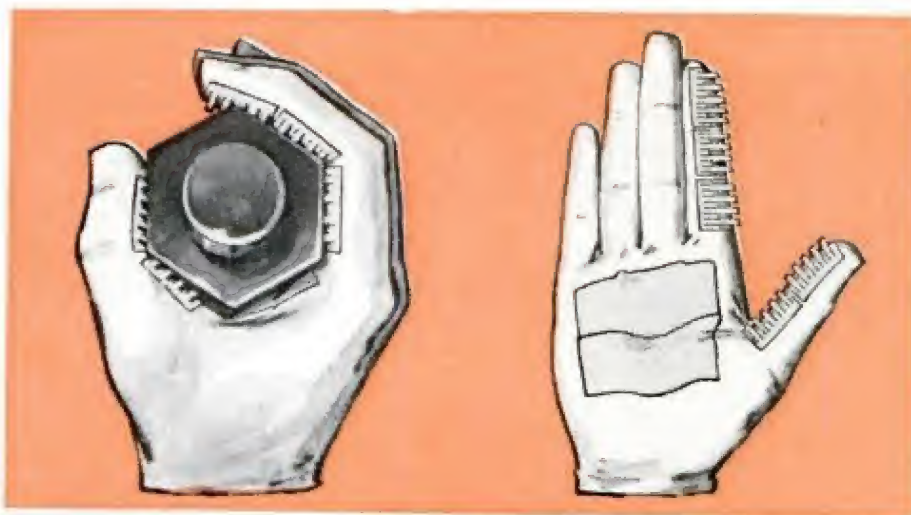




3. FLYING OUTBOARD gives you the thrill of soaring through the air without ever leaving the water. The wing and cockpit section is propelled by a conventional outboard engine at end of a long boom. As speed increases, the cockpit lifts a few feet

off the surface, while the outboard unit remains in the water. Airplane-type ailerons and elevator let you bank, climb and dive just as if you were really flying. The wing is pivoted so it assumes a level attitude in flight, even with the cockpit tilted up

4. YOUR HAND is a wrench with glove at right. Ribbed plastic inserts attached to both the thumb and fore-finger form hexagonal jaws when you wrap your hand around a nut. The glove is designed for use in hard-to-reach places where a conventional wrench would be difficult to handle, such as opening a plumbing drain under a sink. It can also serve as a second wrench where you need to hold one end of a bolt or pipe from turning while threading nut or fitting on the other end



5. YOU SLEEP ON WATER in this novel bed. The water-filled plastic mattress is said to provide a firm, yet soft, support with a pleasant, sleep-producing floating sensation. A built-in heater keeps

the water at any desired temperature and is thermostatically controlled like an electric blanket. The bed is filled from a faucet through a hose. Stiffness is adjusted by varying the amount you put in

Inventors of the items shown on these pages are as follows: 1. Robert D. Green, Ethiopian Air Lines, Box 1755, Addis Ababa, Ethiopia (No. 3,512,825); 2. Clark L. Selby, Jr., 9543 Walmer Lane, Overland Park, Kans. (No. 3,503,480); 3. David F. Thompson, 204 Wildwood Ave., West

Chester, Pa. (No. 3,522,785); 4. Albert B. Meszaros, 24 Eastern Ave., Ossining, N. Y. (No. 3,500,477); 5. Inner-space Environments, Inc., 584 Pacific Ave., San Francisco, Calif. Roger S. Shashoua is located at the International Inventors Assn., Inc., 680 Fifth Ave., New York, N. Y. 10019.



Mach 7 engine

A stream of hot gases moving more than seven times the speed of sound was blasted at NASA's Hypersonic Research Engine in its first wind-tunnel tests. The tests are intended to demonstrate that the liquid-hydrogen-cooled engine can withstand Mach 7 flight.



Plans to fly his car

Erwin Stockwell, a retired toolmaker who has flown for 37 years, plans to continue his flying in his aeromobile—a standard car with wings, propeller and an extra engine added. Stockwell is assembling the vehicle in his back yard in Orange, Mass.



Two new Discoverer motor homes; one model has front drive

Two sleek motor-home models are being produced by Rectrans, Inc., a new recreational vehicle company. The Discoverer 25 (above) is mounted on a standard 159-inch-wheelbase, motor-home chassis. The Discoverer 27 is on a 180-inch-wheelbase chassis and uses a front-wheel-drive Olds 455-c.i.d. V8. Both models have panoramic windshields, L-shaped dinettes, and sleep six. Side and roof panels are of Dynafoam "sandwich" construction with fiberglass reinforced plastic used as outside skin and aluminum inside.



New hovercraft ferry to start work this year

A new hovercraft, the 85-ton VT1-001, built by Vesper Thornycroft, will go into ferry service on the English coast this year. The 40-knot craft can carry 146 passengers and 10 cars.



And it doesn't produce smog, either

When a bicycle is crossed with a car, you get a pedal car—in this case, a vehicle that was able to travel from London to Paris in 28 hours (not counting the Channel crossing). Built by factory apprentices, it has 10-speed derailleur gear, rear-wheel brakes and lights.



Vauxhall stylists show how they think a car should look

Just 41½ inches high, the Vauxhall SRV (Styling Research Vehicle) is a four-seat, four-door car that incorporates such ideas as an airfoil in the nose for trimming the car at high speeds and an electric leveling system. Too bad, though; it won't be for sale.



EVEN DURING GUN SEASON rack can be handy hanger for rope, lights and other outdoor gear



A LOCKING DEVICE is a must these days if you live near a big city. It's also helpful for securing any loose gear you may carry in the off season

Let Your Gun Rack Work Year Round

By L. A. WILKE

GUN RACKS in trucks and wagons have many uses other than holding firearms. They're supporting everything from rolled blueprints to diaper bags!

Originally intended for pickup trucks and fastened over the back window, gun racks are now being installed in station wagons lengthwise in the luggage area and in passenger cars under the trunk lid, or behind the driver's seat. Most are adjustable, with spring-steel clips or hooks covered with a plastic material to prevent marring.

The standard rack has three clips and prices start at \$3.95. Metal screws sold in some packages will occasionally work loose with heavy loads and over rough roads, but ordinary lagbolts should hold permanently.

If your wife balks at having a rack in the family car, point out how convenient the hooks are for carrying parasols or kiddies' playthings. And, of course, you'll need 'em for your fishing tackle in the spring! ★★★

POPULAR MECHANICS

BOATING TIPS

A CONVINCING ARGUMENT for trading up from a runabout to a small, hardtop cabin cruiser is the windshield with side curtains—protection to keep charts and cockpit dry, even in choppy weather. But beware the salt if you're a coastal boater! Big solid splashes of seawater are easily cleared by windshield wipers, but intermittent splashes of fine spray dry to leave a film impervious to unmoistened wiper blades. You'll have to either reach around to splash fresh water on the blades, or open the windshield. Either "solution" defeats the purpose of a windshield in the first place.

For less than \$10—starting with a \$4.95 automotive windshield washer from an auto supply store—I solved the seawater problem. A suction and pressure pump is easier to install than a battery type, but both work well. Plastic tubing from an aquarium-supply store provided me with a water connection from the solvent bag. Spray heads were set above the windshield wipers, tubing disguised against the aluminum windshield frame with aluminum-colored Scotch tape, and solvent supply concealed in a sliding cabinet in the head, providing easy access for filling. For that \$10 outlay and an afternoon's efforts, you can insure clearer, safer vision wherever you boat.—*D. W. Smith*



MOST OUTBOARD MOTORS are sold with a 6-gallon gas tank, and that's hardly enough for water skiing or extended cruising. Most boaters need a larger, permanently installed fuel system. A number of firms (such as Tempo Products below) make auxiliary units, or with a little work you may find that a salvaged auto tank does the trick for half the cost.—*T. J. Jackson*



New Quickie Kits

Prewired subassemblies and a clever all-purpose cabinet make this low-cost line of amplifiers easy and fun to build. You can also use the parts to design your own circuits.


WHEN YOU BUY one of these new hi-fi kits, you get it half-assembled for you. The main controls, transistors, resistors, capacitors and other small parts are neatly mounted on a prewired printed-circuit board. All you do is make a few additional connections and the unit is ready to play. Low in cost and easy to assemble, the kits are ideal for putting together an inexpensive hi-fi system, musical-instrument amplifiers or public-address equipment.

The Calectro-Amperex kits are designed for maximum flexibility—you buy only what you want. You can purchase the prewired subassemblies separately for developing your own sound system, or you can get all the parts needed for building a complete piece of audio equipment. The kits are based on preassembled modules for five different solid-state amplifiers, all designed to fit into a trim, walnut-finished enclosure about 12 inches long by 3½ inches high. The five modules include an 8-watt stereo amplifier for \$29.95, 20-watt stereo amplifier for \$39.95, 10-watt guitar amplifier for \$27.95, 30-watt guitar amplifier for \$44.95 and 20-watt ultralinear monaural power amplifier for \$26.95. The output ratings are for peak power; RMS ratings are about half.

The two stereo amplifiers have built-in volume, tone and balance controls as part of the basic module. The two guitar amplifiers have volume, tone and tremolo controls. The 20-watt power amplifier, without controls, is designed for use with a separate control preamp.

To complete each module, you need a

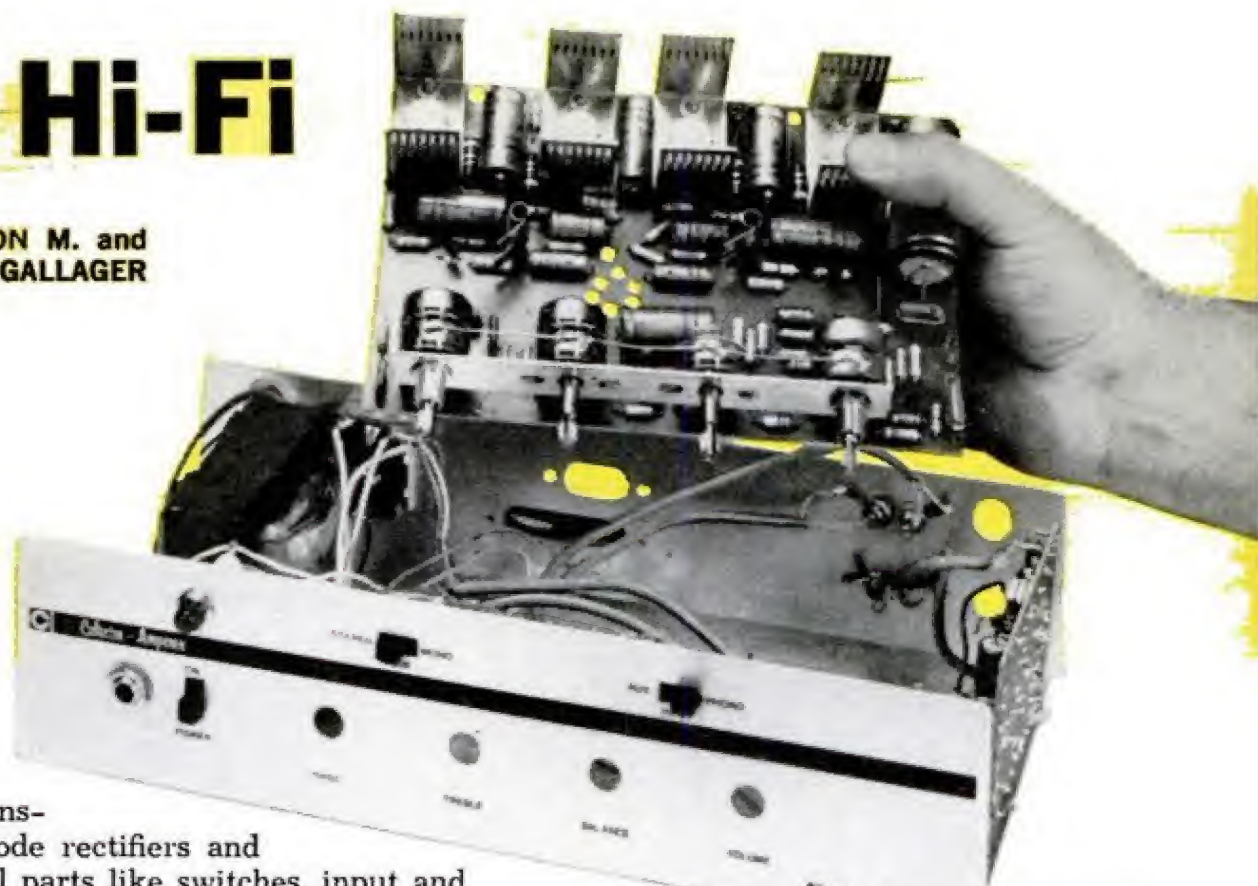
POPULAR MECHANICS



SECRET OF LOW COST is clever aluminum chassis stamped out to take any amplifier module used. Interchangeable front panels hide unused holes, and walnut-finished cover gives trim appearance. Stacked at top are 30-watt guitar amp, 20-watt power amp and 20-watt stereo amp all boxed in same enclosure

for Hi-Fi

By SHELDON M. and
SCOTT M. GALLAGER



power trans-
former, diode rectifiers and
other small parts like switches, input and
output jacks, fuse holders and pilot lights.
You can add these yourself or buy them
in a handy accessory kit (\$7.95 to \$11.95).

The walnut-finished enclosure is also
available as an accessory for \$11.95. It in-
cludes a prepunched aluminum chassis
with holes to suit any of the basic ampli-
fier modules. To cover the front, you paste
on an attractive, gold-toned, self-adhe-
sive panel supplied with each module.
This conceals the unused holes and pro-
vides the correct openings for the particu-
lar module you've selected. One enclosure
serves all five modules interchangeably.

Except for the power amplifier, all
modules have output connections for
standard 8-ohm speakers. Any conven-
tional music source—phonograph, tuner
or tape deck—can be plugged into inputs
on the two stereo hi-fi amplifiers. If you're
using a magnetic phono pickup, a small
preamp is required in addition to the
main amplifier. This is available as a
separate prewired module for \$14.95. The
two guitar amplifiers have inputs for both
normal and solo instruments and are
wired for foot-switch tremolo control.

The sound you get from these packaged
modules is surprisingly clean and power-
ful, and the kits offer a lot of value for the
money. Sold under the Calectro-Amper-
ex name, they're made by GC Electronics,
400 S. Wyman St., Rockford, Ill. ★★ ★

FEBRUARY 1971



AMPLIFIER MODULES come bubble-packed in a va-
riety of types and sizes. At center is universal en-
closure designed to fit all. A typical module, com-
plete with volume and tone controls, is shown be-
ing inserted in a stereo amplifier at top of the page

NEW IN ELECTRONICS

TINY 2-WAY CB TRANSCEIVER works anywhere—as a base station at home, as a mobile unit in a car or boat or as a portable walkie-talkie. Only five inches wide, it has five watts of power—the maximum FCC limit—and offers up to 12 Citizens Band channels. The 12-volt Micro-12 is \$79.95. For home use, an accessory a.c. power supply is \$19.95. For portable use, there's a handy carrying case with built-in battery pack, also \$19.95. Lafayette Radio, 111 Jericho Turnpike, Syosset, N.Y. 11791.



MINIATURE RADIO, developed by the Russians as a by-product of space research, is one of the world's smallest. No bigger than a matchbook, it receives long-wave commercial stations and some medium-wave special broadcasts. Its battery gives up to 15 hours of continuous use. A tiny earphone is used for private listening. The Russians plan to sell the radio in England, possibly in the United States.



ANTITHEFT ALARM FOR CARS installs in minutes with no special tools. Unlike systems requiring tripping switches, it simply hooks into the ignition wiring and detects any slight current drain on the battery. If someone opens a door, turning on the dome light, or tries to start the car, the device senses the voltage drop and sounds a loud warning. \$29.95, GC Electronics, 400 S. Wyman St., Rockford, Ill.



FIRST COMBINATION of TV set and tape recorder will be in this novel Panasonic hybrid, due later. The battery-powered portable packs a 3-inch mini TV screen and a cassette recorder into a slim, compact carrying case weighing only 10 pounds. The screen pops up for viewing (far left) and retracts for carrying. Price has not yet been announced.

POPULAR MECHANICS

New in Photography



YOU CAN PUT SOUND ON FILM with this packaged system designed for low-cost home use. It consists of a Super-8 movie camera, a special synchronized cassette tape recorder and a Super-8 sound projector. During filming, sound is recorded on tape in step with the camera. But unlike other systems, the tape is

used only for the original sound track. During processing, the film is magnetically striped at the factory and the sound is added from the tape. The sound is then played back through the projector when the movie is shown. Price is \$320 for the complete system. Synchronex Corp., 635 Madison Ave., New York, N. Y.



ROLLEI'S LONG-AWAITED ENTRY in the 35-mm single-lens reflex field is expected to be on the market this month. Said to be lighter and more compact than many current SLRs, the new Rolleiflex SL35 has a through-the-lens metering system and a self-starting frame counter that needn't be set at the start of each roll. Six interchangeable lenses, 25 to 200 mm, will be available. Price, around \$300.

FEBRUARY 1971



POLAROID OWNERS can add electronic flash to their cameras with this special adapter for a Model 180 Vivitar strobe. The adapter mates the strobe to most Polaroid models and permits Polacolor close-ups to be made at 3½ to 6 feet with the flash set on low intensity. On high intensity, shots can be made at up to 10 feet. Price of PFA-1 adapter is \$6.95. Ponder & Best, 11201 W. Pico Blvd., Los Angeles, Calif.

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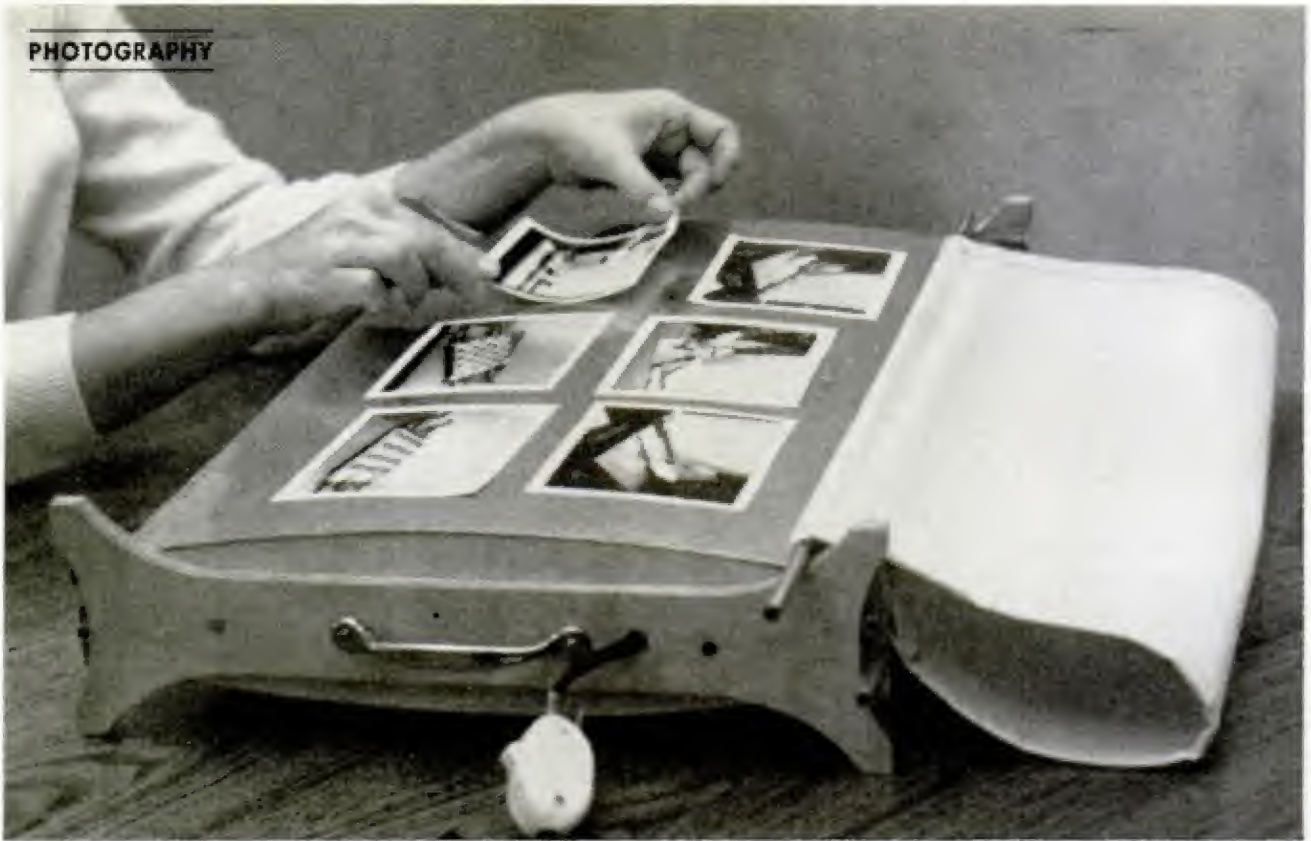


Photo Print Dryer You Can

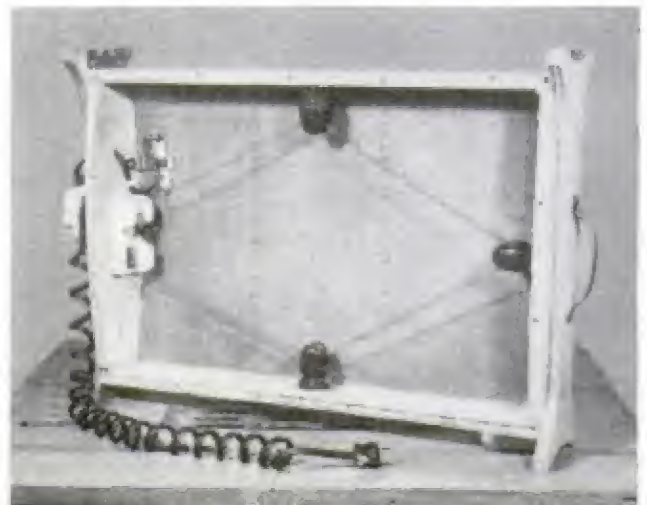
A simple plywood frame and an old heating coil will speed your dark-room work for only a few dollars

IF YOU'RE TIRED of waiting hours for your prints to dry on a ferrotype plate, you can build this electrically heated dryer and have them ready in a fraction of the time. The double-sided design provides drying surfaces on both sides. Wet prints are laid out on metal sheets and held flat by canvas retaining strips hooked over the ends and pulled taut. There's room for two 8x10s on each side or four 4x5s.

The frame is made of plywood scrap. Two sidepieces serve both as legs for the dryer and hooks for stretching the canvas over the prints. Screwed to the frame are metal sheets to conduct heat. These can be thin aluminum, stainless steel or galvanized—almost any sheet metal will do. Reynolds aluminum is readily available at hardware stores in $\frac{1}{16}$ -inch sheets. You can size the dryer to take ready-made cookie sheets or stock ferrotype plates.

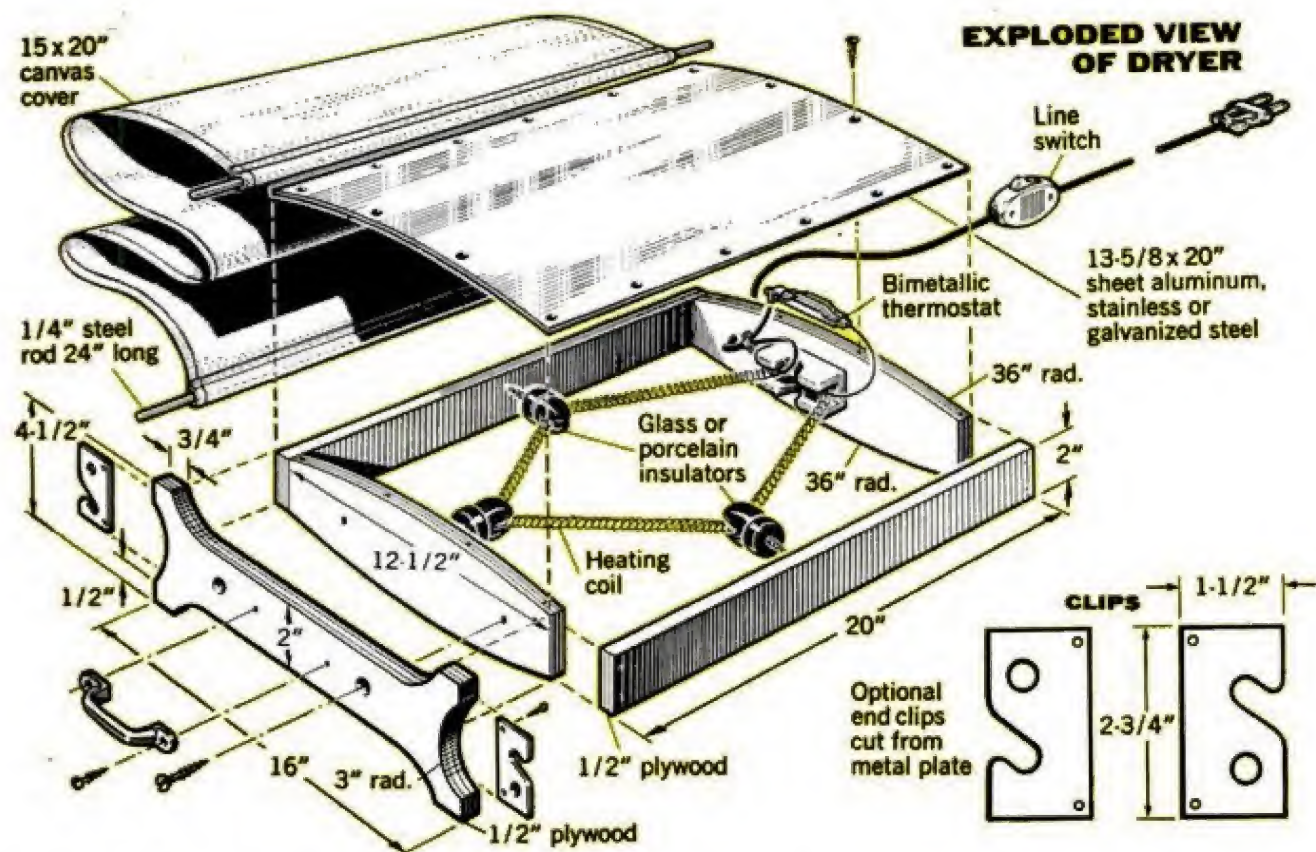
Supported inside the frame is the heating element from an old space heater. Wired

in series with the coil is a bimetallic thermostat from an electric coffeemaker to keep the heat constant. If you can't scrounge these items from around the house, replacement heating coils and thermostats can be purchased at electrical appliance stores. Measure the length of coil you need, then buy one as close as possible to this length. A coil can be stretched or shortened slightly to adjust its length, but



HEATING COIL inside the dryer is strung through glass or porcelain insulators of the type used to anchor radio antennas. Be sure that the coil doesn't sag and touch the metal drying plates at any point

POPULAR MECHANICS



Build for Peanuts

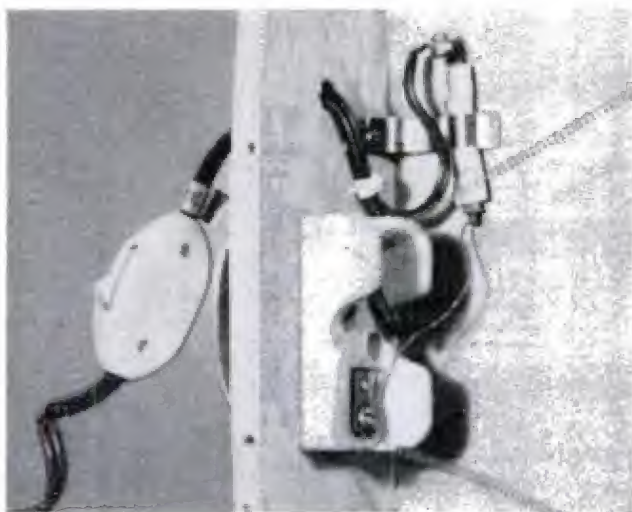
By JAMES A. JOYNER

don't cut off much or you will change its electrical resistance.

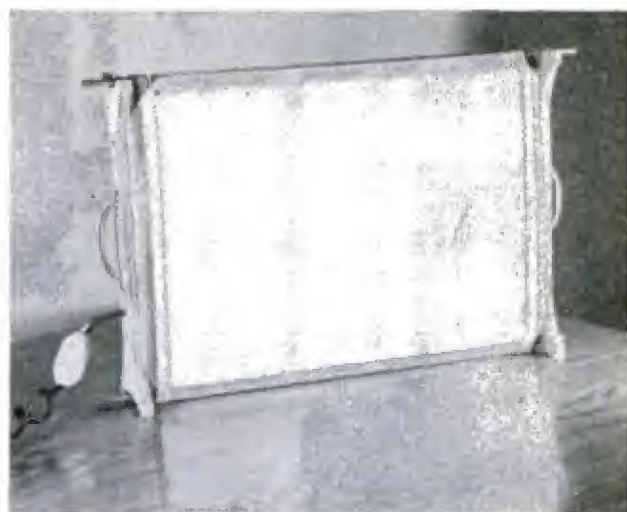
String the coil through insulators as shown. The ends are connected to screws on a large porcelain fuse holder serving as a terminal block. Any similar insulated terminal block will do. One lead of the power cord is connected directly to one end of the coil on the block. The other is attached to the thermostat, which is

connected to the other end of the coil.

The canvas covers are held in place by metal rods. Have your wife sew pockets in the ends to hold the rods. The rods can be hooked over the legs or, for a neater arrangement, you can make the metal rod holders shown in the drawing above. In use, the dryer is loaded one side at a time in the flat position, then it's stood upright during the drying period. ★★★



FUSE HOLDER serves as insulated terminal block for fastening ends of heating coil. Note how tubular thermostat is mounted against one of the metal drying plates with small clip bent from metal strap



IN UPRIGHT POSITION, dryer is well ventilated and both sides receive heat evenly. Screen-door handles at ends facilitate turning and carrying it. Line switch in the power cord is within easy reach

Those New Gasolines:

How to Pick the Right One for Your Car

By MORT SCHULTZ

Illustrations by Peter Trojan

THE GASOLINE GUESSING GAME has been with us for a long time. Because most oil companies do not post octane numbers on their gas pumps, about all you have been able to do is to resort to trial and error and keep your own record of which fuels knock in your car and which do not.

Now, with nearly every oil company selling no-lead or low-lead gasoline, the guessing game is more confused than ever. Why no lead? What are the advantages of leaving it out? Disadvantages? The answer depends on to whom you're talking. No-lead gas is supposed to reduce air pollution—not so much by reducing lead in the air as by extending the life of the new, experimental catalytic mufflers (which now cost about \$200) from approximately 10,000 miles of operation to 50,000 miles. In a catalytic muffler, which is the most effective exhaust emission-control device yet developed, the exhaust reacts chemically with a catalyst to convert pollutants to harmless carbon dioxide, nitrogen and water

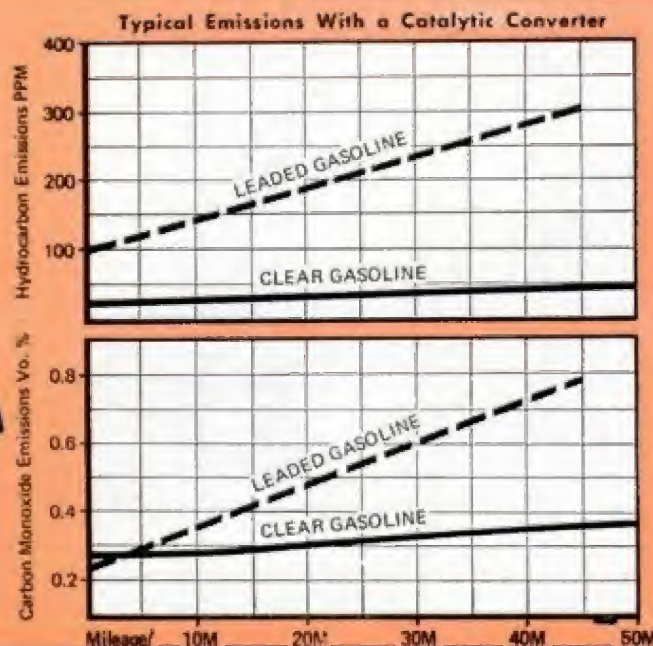
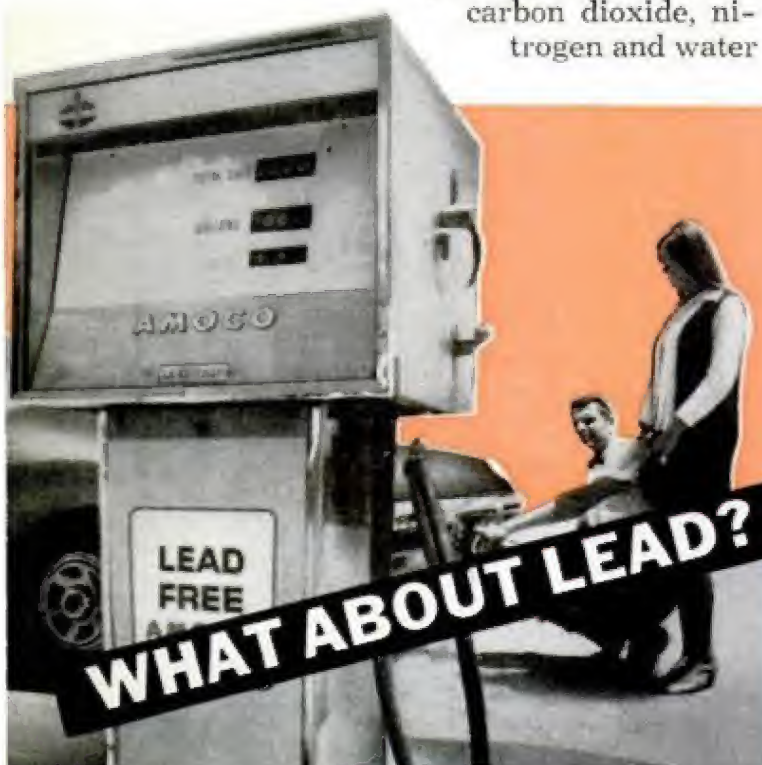
vapor. The real benefit of unleaded gasoline on air pollution, then, won't be realized until 1975, at the earliest, when General Motors says it will equip all of its new vehicles with catalytic mufflers.

So why push lead-free gas now? One reason is because it will take time to introduce unleaded fuel on a nationwide basis. Another is to obtain some secondary benefits of unleaded fuel at once, such as a reduction in lead emissions.

A vice-president of the Continental Oil Co. argues there is little point in omitting lead from gasoline until the catalytic muffler is in wide use. Lead, he insists, is an insignificant pollutant.

This may be true, but where *does* the lead go? To what extent does it get into the human body and what are its effects? We can't assume that lead emissions are harmless until they're proven otherwise.

Still, the high-compression engines on the majority of cars of 1970 and earlier vintage aren't able to burn unleaded fuel without knocking. While there are exceptions, most gasolines have lower octane ratings than comparable grades of leaded



fuel. Lead additives, particularly tetraethyl lead, have been mixed into gasoline since 1923 to increase the fuel's resistance to combustion-chamber heat and pressure. In the absence of lead (or sophisticated, expensive refining to increase a fuel's resistance to heat and pressure), gasoline will explode rather than burn smoothly. This is called detonation (or knock).

The more lead you add to gasoline, the greater will be its resistance to detonation. This resistance is reflected by the fuel's octane rating. Thus, 100-octane leaded gas has greater resistance (and more lead) than 96-octane leaded gas.

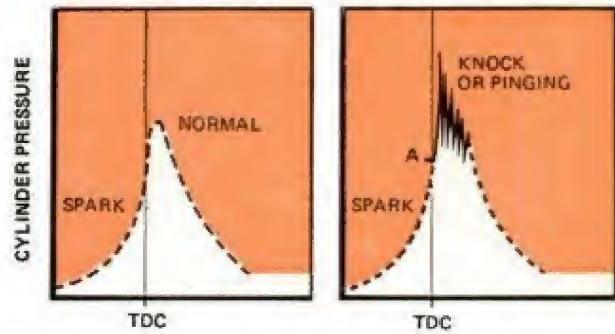
Octane rating is obtained by comparing a gasoline's resistance to detonation with a blend of isooctane and n-heptane (the *n* stands for normal). Isooctane has maximum resistance to detonation and an octane number of 100. N-heptane has no resistance to detonation and an octane number of 0.

Thus, if gas is rated at 94 octane, it has the same resistance to detonation as a mixture of 94 percent isooctane and 6 percent n-heptane.

Octane ratings of leaded gasolines differ widely from one section of the country to another and from brand to brand. The number for regular fuel ranges from 90 to 96, that of premium, from 97 to 103.

The octane rating of today's unleaded gasoline, on the other hand, is about the same from brand to brand: 91. But some oil companies have taken a middle-of-the-road position. They sell a low-lead gasoline, claiming that you need some lead

Pressure-Time Relationships for Combustion



RESISTANCE OF FUEL to self ignition from heat in cylinder depends on octane number. Fuel should burn smoothly and evenly as flame front advances through combustion chamber. Self ignition creates sharp pressure changes that result in knocking

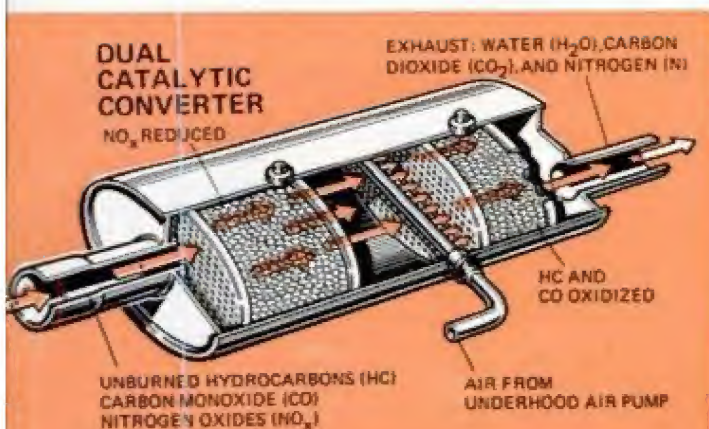
to prevent valve problems. The octane rating of low-lead gas is from 94 to 96.

Incidentally, most regular leaded gasolines contain up to 2.5 grams of lead per gallon, while low-lead gas has a maximum of 0.5 gram of lead per gallon.

Whether lack of lead does lead to valve trouble is another question. The Chrysler Corp. contends that lead protects engine valve seats. American Oil Co., on the other hand, which has been selling no-lead premium in the eastern half of the United States for almost 50 years, replies that it has never had a complaint about valve problems in cars using its lead-free fuel.

One thing is certain. If valve failure becomes a problem because of no lead in gas (in theory, lead helps eliminate valve pounding by acting as a buffer between valve and seat), a different chemical

LEAD FOULING is evident on plug which was run for 12,000 miles in engine using leaded fuel. Plug at the right was run 50,000 miles on unleaded gasoline



GETTING LEAD OUT is mainly to halt rapid disintegration of expensive catalysts in exhaust-cleaning converters to be original equipment on production cars in few years. Charts show rise in HC and CO emissions using leaded fuel with converter. Also under study: health hazard of lead in the air



additive may be tried or more durable valve materials developed.

When you buy leaded gasoline you are getting increased resistance to detonation. How can this resistance be obtained if lead is "outlawed"?

Most oil companies, whether producing no-lead or leaded gasoline, start with a "regular" having an octane level ranging from 86 to 90. To increase this rating the refiners can add lead. Or they can use more intricate and expensive refining methods. An oil company can get any octane level it wants by refining and re-refining a gasoline to alter its molecular structure. But lead is cheaper. For that reason, unleaded (and low-lead) gasoline is costing customers from one to six cents per gallon more than leaded fuel with comparable octane.

What does all this mean as far as your car is concerned?

Practically every pre-1971 car requires gas with an octane rating of at least 92. An exception is Volkswagen, which will run okay on 91-octane.

This year's models are different. Almost all engines have been redesigned to allow use of lower-octane fuel. Every 1971 General Motors car, 1971 FoMoCo cars except those having 429 and 460-cu.-in. engines, and 1971 AMC cars except those with a 401-cu.-in. engine will operate without knocking on 91-octane fuel.

Chrysler says 93 percent of its 1971 models will operate on 91-octane gas, but recommends that low-lead (not no-lead) fuel be used because of the valve problem.

If 91-octane fuel is recommended, it means that unleaded regular gas can be used (Chrysler notwithstanding). However, keep in mind this important fact: These 1971 engines will perform just as well on low-lead and fully leaded gasoline.

Octane requirement is the name of the game. The octane requirement of an engine depends on compression ratio, ignition timing and combustion-chamber design. The lack of just one octane unit can cause knock.

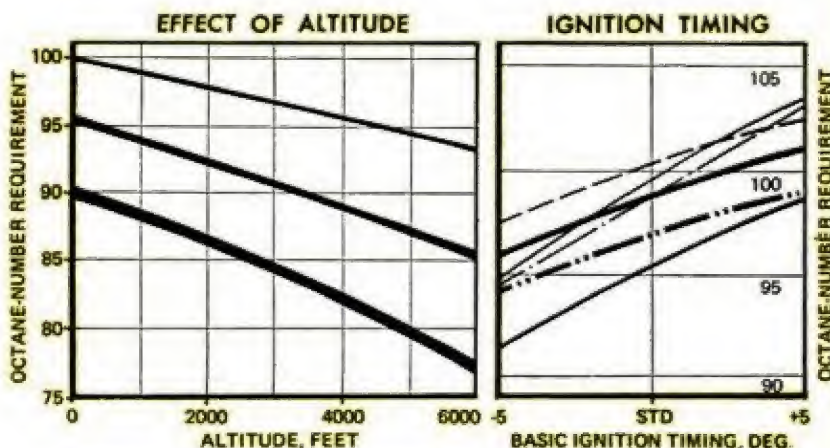
Actually, knocking can occur without your hearing it. But if you can't hear it, there's nothing to worry about. "Detonation per se is not harmful to engines as long as it is of light intensity," says Bernard Rosen, director of product and process research for Cities Service.

A heavy knock is something else, however. So what do you do? The answer to this question offers the logical way to select gas with the correct octane level for your car.

Start with the grade (regular or premium) of fuel suggested by the manufacturer of your vehicle. If a knock becomes audible, switch to a different brand of the same grade.

Within a geographical area, octane ratings differ from brand to brand and, unfortunately, ratings are seldom posted. In the east, for example, Sunoco 200 (leaded) has an octane rating of 94, Phillips 66 regular (leaded) has an octane rating of 95 and American regular (leaded) has an octane rating of 96.

In the Los Angeles area, the octane



POSTING OF OCTANE NUMBER is not required by law, so only a few oil companies post this measure of fuel's resistance to detonation. Engine's octane-number requirement depends on more than compression ratio. It decreases with altitude, for example, as shown in graph at left for engines needing 90, 95 and 100 octane at sea level. Graph at right shows need for higher octane in six different engines as ignition is advanced



rating of Esso Extra (leaded premium) is 99 while that of Texaco Sky Chief (leaded premium) is 100.

This is not intended to suggest that a gas having a lower octane may not be as good as one having one or two octane units higher. Excess octane is of no value. It doesn't give an engine more power. It doesn't keep an engine clean. In fact, says J. H. MacPherson, vice-president of Chevron Research Co., you should use gasoline having the lowest octane rating that doesn't produce knock in your car.

When you switch your brand of gas, it won't take you long to determine if it's of the octane level your engine needs. An engine burning fuel too low in octane begins to knock when that fuel enters its cylinders. Similarly, once the engine gets a gas that allows it to resist detonation, it will stop knocking.

Bear in mind, however, that high-octane gas isn't always the solution to detonation. Overadvanced ignition timing, high cooling-system temperature, and a lean air/fuel mixture—any of these can make an engine designed to operate on regular fuel knock even when premium is used.

A proposal before the Federal Trade Commission—if it passes—will make it easier for you to determine the octane rating of the gas you buy. It calls for posting of the octane ratings on the pumps.

Now, what about those 1971 engines designed to run on 91-octane unleaded gas? As we said, unleaded gasoline won't really begin to reduce air pollution until cars have catalytic mufflers. Even so, there are

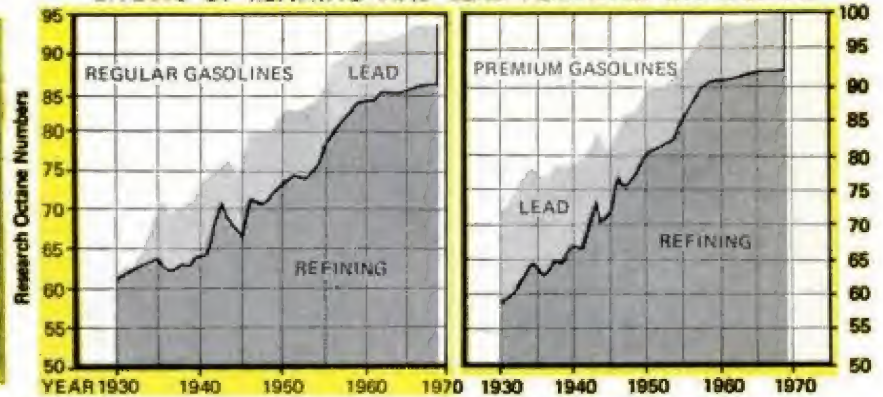


CATALYTIC CONVERTER to be installed on 50 of Chicago's city-operated automobiles is described to H. W. Poston, Chicago's commissioner of environmental control, by J. O. Logan, president of Universal Oil Products. UOP is a leading company in research and development of catalytic processes for industry

several real benefits in using unleaded gasoline now: You'll eliminate lead fouling of sparkplugs and minimize deposits that build up on valves, pistons and other engine parts. And you'll reduce the corrosion of your present, regular noncatalytic muffler. ★ ★ ★



EFFECTS OF REFINING AND LEAD ADDITIVES ON OCTANE



REFINING TECHNIQUES over the years have raised the resistance of fuels to detonation and made possible the modern high-compression internal-combustion engine. In the 1920s it was found that a pinch of tetraethyl lead raised octane number without further refining and it has been used for that purpose since then. Always use gasoline of the minimum octane (and therefore price) that you can. There's no benefit to using a higher octane number

How to Use the TACH-DWELL for Perfect Tune-Ups

You can get an acceptable tune-up 'by ear' but if you want to be right on spec, you'll invest in a good measuring instrument.

By MORT SCHULTZ

WHEN YOU DO your own engine tune-ups you really need a tach-dwell tester, which measures engine speed and the time that distributor breaker points remain closed.

You could probably get along without the distributor or dwell-test part. A feeler gauge is not 100-percent accurate, especially if points are slightly corroded, but it will put you somewhere in the ballpark on point adjustment.

However, you can't measure engine revolutions per minute by ear, eye or feel, and since most engine adjustments must be made at a specified speed, there's no way to get around the need for a tachometer.

There's another reason why a tach is necessary. A modern engine requires that speed be set to within 10-15 rpm of specification at idle to insure proper operation of an automatic transmission and carburetion. You can't get this close without a tach.

So why not buy only a tach? Because you can buy a tach-dwell for practically the same price.

The circuitry necessary for both functions is practically the same. For both rpm and dwell readings the circuit allows a preset amount of charge through the meter each time distributor points open and close.

Distinction between rpm and dwell is made primarily by a switch that allows

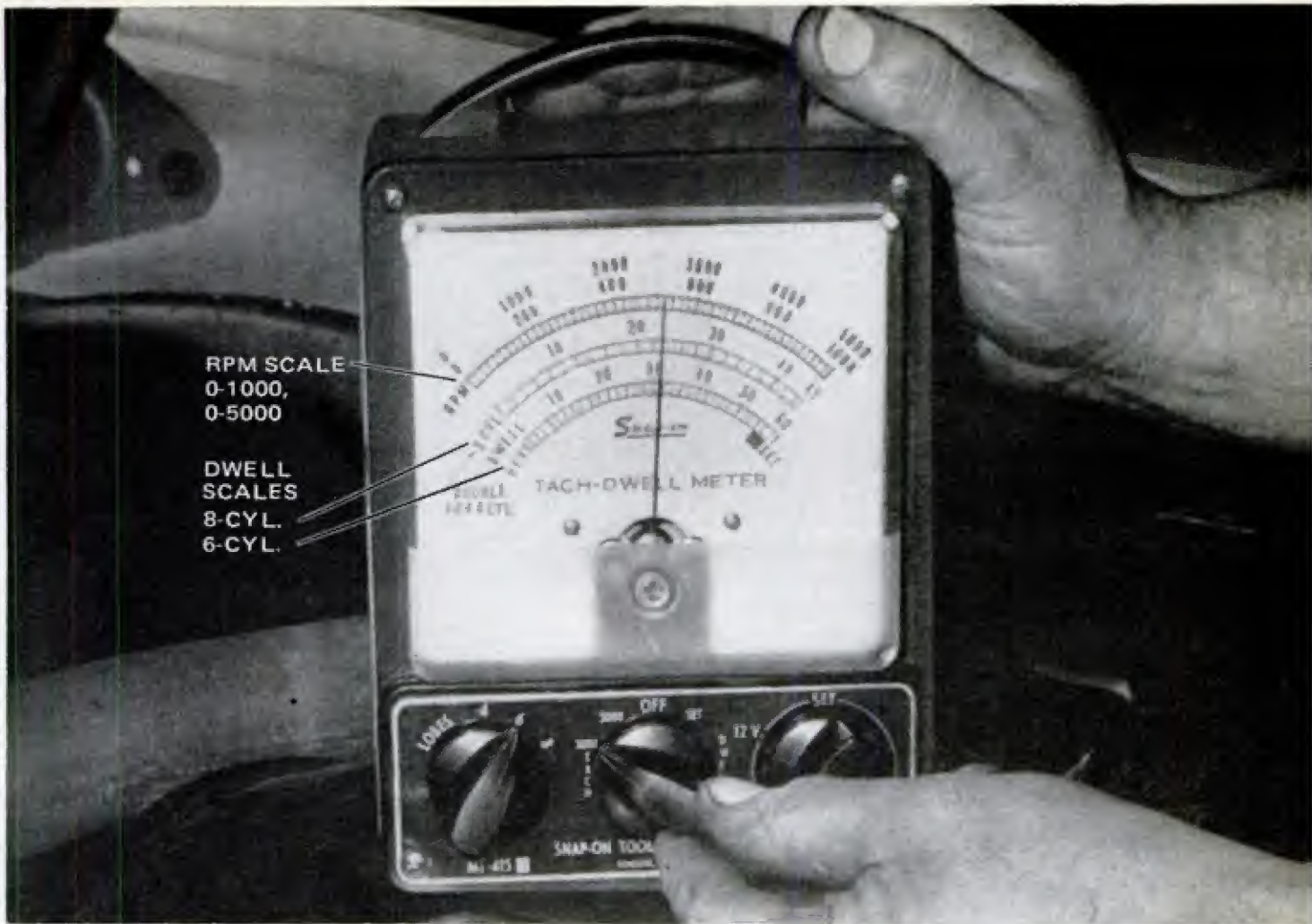
you to transfer from rpm (tach) scale to dwell scale. This switch adds a few dollars to the cost of the instrument, but it's worth the extra money to get the dwell feature.

The dwell meter portion of the instrument measures the percent of time that points remain closed and converts this into a scaled reading which multiplies the percent of time by 360° divided by the number of cylinders in the engine. For example, if points in an eight-cylinder engine remain closed two-thirds of the time, the dwell reading would be $\frac{2}{3} \times 360^\circ$ divided by 8, or 30°. On a six-cylinder engine, it would be 40°—on a four, 60°.

If point dwell is excessive—that is, if points remain closed too long—too much current would flow through them at low engine rpm and arcing would occur that would reduce point life. Conversely, if dwell is set too low, not enough current would flow in the coil at high speeds to provide sufficient spark to fire sparkplugs. Poor high-speed performance would be the result.

To check dwell, warm the engine to operating temperature, calibrate the meter using the zero adjustment button, screw or switch on your unit and connect the leads. The hookup for all tests done with the tach-dwell is the same.

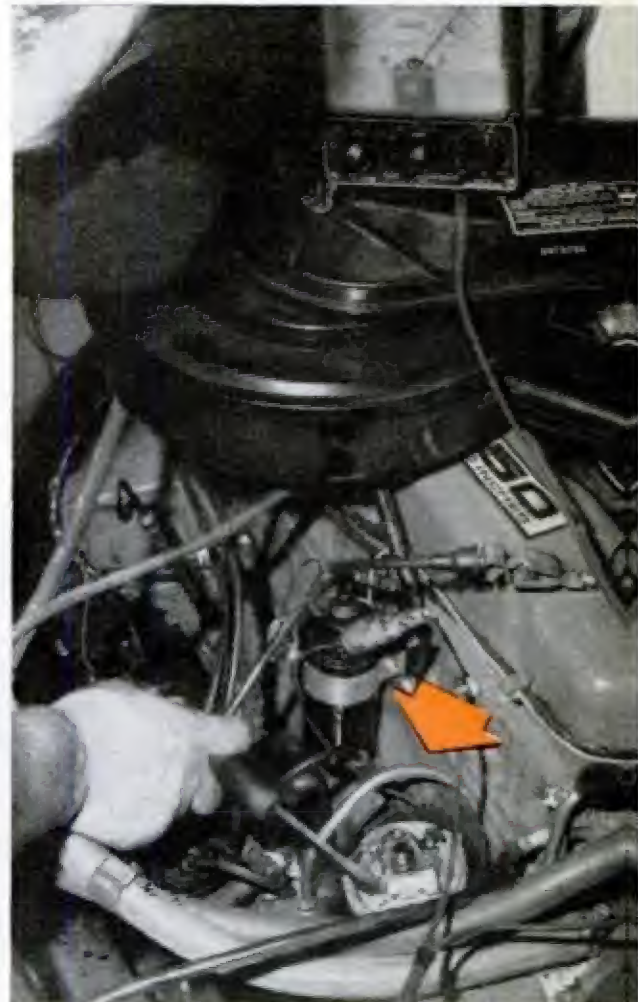
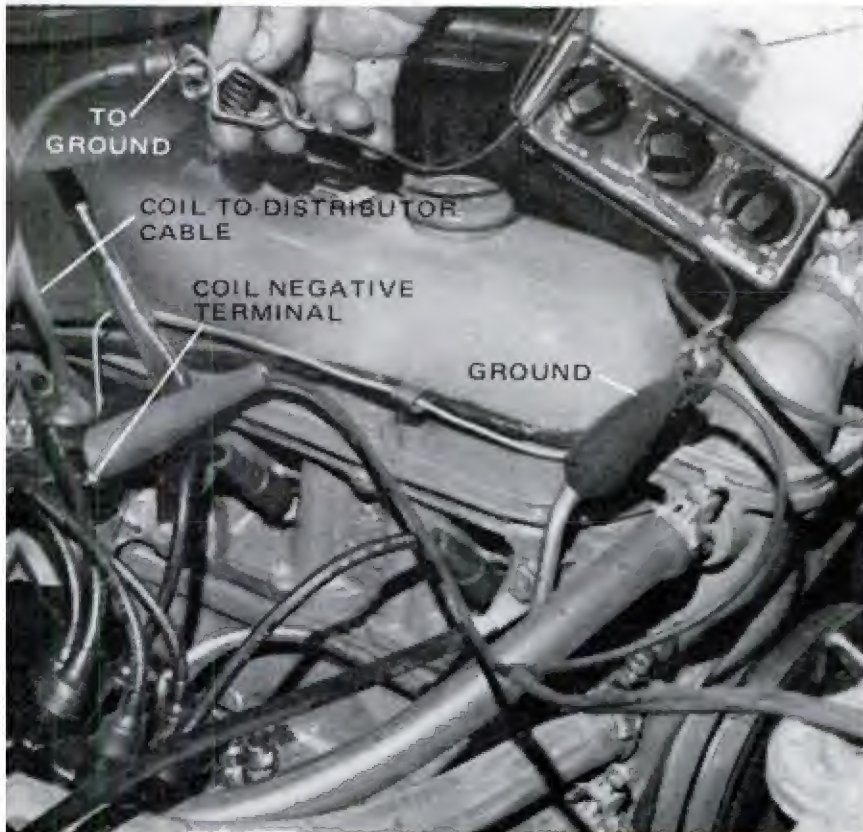
The unit's black lead is connected to a clean ground on the engine. The red lead is connected to the distributor primary



RPM SCALE
0-1000,
0-5000

DWELL
SCALES
8-CYL.
6-CYL.

TYPICAL TACH-DWELL METER has high and low rpm ranges, and scales for six, eight cylinders. For four cylinders, the eight-cylinder scale is used and reading doubled. Connections for dwell-tach (below) are simple (see text). Points are adjusted (below right) to bring dwell reading within the manufacturer's specification



terminal at the coil. This is assuming that the car's electrical system is negative ground, as most are. If by some chance you should have a positive-ground system, reverse the leads.

Make sure the tester's selector switch is on *dwell* and start the engine, running it at idle speed. Observe the meter and compare the reading to manufacturer's specifications, which are provided in owner's and service manuals.

This specification is probably given as a range, such as 28°-32°. A reading within this range is normal. However, if the meter shows a higher or lower reading, you'll have to adjust the points.

Shut off the engine and remove the distributor cap and rotor. Remove the coil high-tension cable from the center tower of the distributor cap and connect it to ground by means of a jumper lead. Leave the tach-dwell hooked up as it was before.

Now, turn on the ignition switch and have someone crank the engine as you adjust the breaker points to obtain correct dwell. When this has been done, button everything up and make the dwell test again.

If correct dwell cannot be achieved or maintained, you have a problem inside the distributor with a worn point rubbing block (replace the points) or a worn cam (replace the cam).

With dwell properly set, use the tach-

SET IDLE SPEED on cars with throttle-stop solenoid by turning the adjusting screw while watching tach



dwell tester to check dwell variation, which is the total difference in the meter reading between idle and 1500 rpm. Start by noting dwell at idle.

Switch the tester to the *tach* mode and increase speed to 1500 rpm. Hold it there and switch back to *dwell* position.

Note the dwell reading. It should not have changed by more than 2° from the idle reading on most engines, but make sure that you check the manufacturer's dwell variation specification before condemning the distributor.

Suppose, for example, that the dwell specification for your engine is 28°-32° at idle, and you obtained a reading of 28° at idle. This means that at 1500 rpm your reading should be 26°-28°. If it isn't, you have a bad vacuum advance, worn or loose distributor shaft, worn distributor bushings, or a worn distributor breaker plate.

A word should be said about engines that have dual point distributors. The number of degrees of dwell measured with the engine running is the combined total of both sets of points. However, when adjusting dual distributor points, one set of points should be blocked open while the other set is being adjusted.

To use the tachometer part of the tach-dwell tester for making tests to manufacturer-specified rpm, hook up the instrument's leads as mentioned before. Some test instruments have a selector switch for four, six and eight-cylinder engines. Others have individual scales on the instrument dial—one for eight and one for six-cylinder engines. If you are testing a four-cylinder engine, use the eight-cylinder scale and multiply whatever reading you get by two.

One of the most important uses you can make of a tach is to adjust engine idle speed and mixture. Specifications for your engine can be obtained from the service manual, or in *Motor's* or *Chilton's* auto repair manuals, which can be found in most libraries.

With the tach-dwell hooked up, the selector in *tach* mode, and the engine at operating temperature and idling, adjust the throttle stop or idle adjusting screw to get the idle speed specified by the manufacturer.

Now, turn the idle mixture adjusting screw out until engine speed starts to decrease. Then turn it in until speed in-

creases and continue turning it in until engine speed again begins to decrease. At this point, back out the screw just enough to get the highest engine rpm and the smoothest idle.

If you're working with a two and four-barrel carburetor, repeat the procedure for each mixture adjusting screw (there are two).

Okay, place the transmission shift lever in the position recommended by the car manufacturer (some require neutral—others, drive). If the tachometer now shows engine rpm to be less than specification, readjust the throttle stop or idle adjusting screw and, if necessary, the idle mixture screw(s). For optimum results, this final test should be done with the air cleaner installed and the engine at operating temperature if these conditions weren't present to begin with.

You can buy a tach-dwell for \$12.95, \$75, or anywhere in between. Shop around and compare. By "shop," I mean just that. See what professional auto-supply stores, discount department stores, regular department stores and mail-order houses have to offer. Get specification sheets and study them to see what each instrument offers.

Don't overlook instruments that come in kit form which you put together yourself. They offer good value.

In making comparisons, there are a few things to look for which are more important than others:

- The instrument should have an accuracy of at least 5 percent—2 percent or 3 percent would be better. Anything less accurate makes the dwell function virtually useless.
- Make sure the meter is large and easy to read.
- The unit should be capable of providing readings for at least six and eight-cylinder engines—and four-cylinder, too, if there's a Vega, Pinto, Gremlin, VW, Opel, Datsun or similar car in your future.
- Make sure that a comprehensive instruction booklet is furnished with the instrument.
- Make sure the unit will provide readings at cranking speeds and that it can be used with the ignition system in your car. Many makes of instruments won't work with transistorized and capacitor discharge ignition systems.
- If the unit is powered by battery, de-

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CARBURETOR ADJUSTMENT is made using tachometer to get right idle mixture for optimum performance

termine whether it's a battery that is easily obtainable.

- The impedance of the tester's circuit must be great enough to keep it from altering the electrical properties of the ignition system. This has been a problem with low-priced units, so watch it.
- Check that guarantee and repair service. Tach-dwells have a way of falling off fenders or getting caught in fan belts. Does the manufacturer of the unit provide a practical repair service? And what will it cost?

Following is a list of some instrument manufacturers. To get started in your hunt for a tach-dwell, write and ask them about the units they make:

Accurate Instrument Co., 2435 White Plains Road, Bronx, N.Y. 10467; Fox Valley Instrument Co., 8627 Straits Highway, Cheboygan, Mich. 49721; Heath Co., Benton Harbor, Mich. 49022; Kal-Equip Co., 411 Washington, Otsego, Mich. 49078; Marquette Corp., 3800 North Dunlap, St. Paul, Minn. 55101; Snap-On Tools Corp. 8028 28th Ave., Kenosha, Wis. 53140; Sun Electric Corp., Harlem and Avondale Aves., Chicago, Ill. 60631. ★★



IF YOU'RE GOING AWAY, or looking for a gift for someone about to make a trip, remember the Mini-Valet. This grooming kit offers a fine assortment of high-quality personal essentials and hygiene preparations in compact travel-size containers. Perfect for use at home, in the office or the car, it's priced at \$3.98 plus 50 cents for postage. Head-To-Toe Products, 1697-1725 Elizabeth Ave., Rahway, N.J. 07065 is the maker.

EXCITING NEW PRODUCTS

BY CATHERINE BILSKI



WANT YEAR-ROUND CHARCOAL COOKING? Majestic's Fire-B-Q grill (above) fills the bill—in the fireplace on a cold wintry evening, outdoors on the patio or at a picnic in balmy weather. Designed to hold an adequate supply of charcoal, the unit has a generous 13 by 20-inch surface for cooking. The grill is raised and lowered easily with a crank-type handle. It folds flat for storing and sells for \$18.95 from the manufacturer, the Majestic Co., Inc., Huntington, Ind. 47651.



END THE HAZARDS of slippery rugs and carpets by making them slip-resistant with Rug Gripper Adhesive. It's easy to apply—just dab it onto the back of rugs or carpets with handy dispenser and let it dry. To remove, just peel a rug gradually, starting from one corner. The product, offered in 4-oz. (\$1.25) and 32-oz. (\$3.50) sizes, is manufactured by Carpet Products Co., Box S, Central Square, New York, N.Y. 13036.

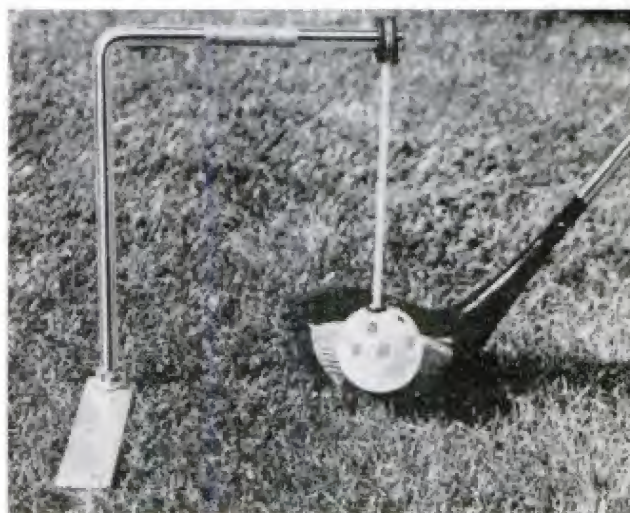


NAUTICAL FLAGS imprinted on sets of oyster-white cups, mugs, tumblers and trays, as well as on a matching ice bucket, shaker/decanter and coffee service, make this jaunty Ship 'N Shore collection of Acca Ware ideal for a boater. Each set is sold individually. A special acetate-covered gift set, consisting of server and six cups, retails for \$18. Available from David Douglas Co., 20 Frederick St., Plymouth, Wis. 53073.

GO IN SNOW with the Novoslei Snow Go-Cart. Besides its attractive, streamlined design, it features a double safety-brake system, step pedals for speed control, angled steering for excellent edging and turning, movable rear skis and a double shock absorber built into the steering device. This easy-to-handle snow vehicle is safe, lightweight and durable, provides hours of winter fun for the entire family. Suggested retail price is \$98. Available from Novelty Imports, Box 53, Cessford, Alta., Canada.



MODEL CAR BUFFS will really go for this rough-terrain Dune Buggy (above). Powered by a Cox .049 Babe-Bee engine, this rugged model can overcome sand, grass, water hazards, jumps and inclines. It measures 14 inches overall and has an adjustable throttle, recoil starter and gearshift. Priced at about \$20, it's made by the L. M. Cox Manufacturing Co., Inc., 1505 E. Warner Ave., Santa Ana, Calif. 92702.



IMPROVE YOUR GOLF GAME at home with a Tee-Off Golf Practice Aid which you can install on the ground wherever there's room to swing a club. It tees itself, there's no ball chasing, and it indicates how you hit the ball: straight, hook or slice. The device is priced at \$5.95, plus 90 cents for shipping and handling, from F. J. Kielian, Specialty Merchandise, 130 Drake Ave., South San Francisco, Calif. 94080.

PERSONALIZE YOUR HOME by spelling name or address with Snap-A-Word letters. These are impossible to misalign because slots engage pegs to eliminate a spacing problem. Tab snapped off last letter (B) is flopped to fill hole (A) in first lower-case letter. Easy to install, letters are weatherproof, and priced at 49 cents each for lower case units, or 59 cents for capitals. Letter House, 8 W. Mineola Ave., Valley Stream, N.Y. 11580.



Things to

Jewelry Keeper

You can quickly build a surefire "corral" to keep your wife's small jewelry—earrings, pins, rings and the like—in one handy spot. The keeper shown is a project you can easily whip out in one day.

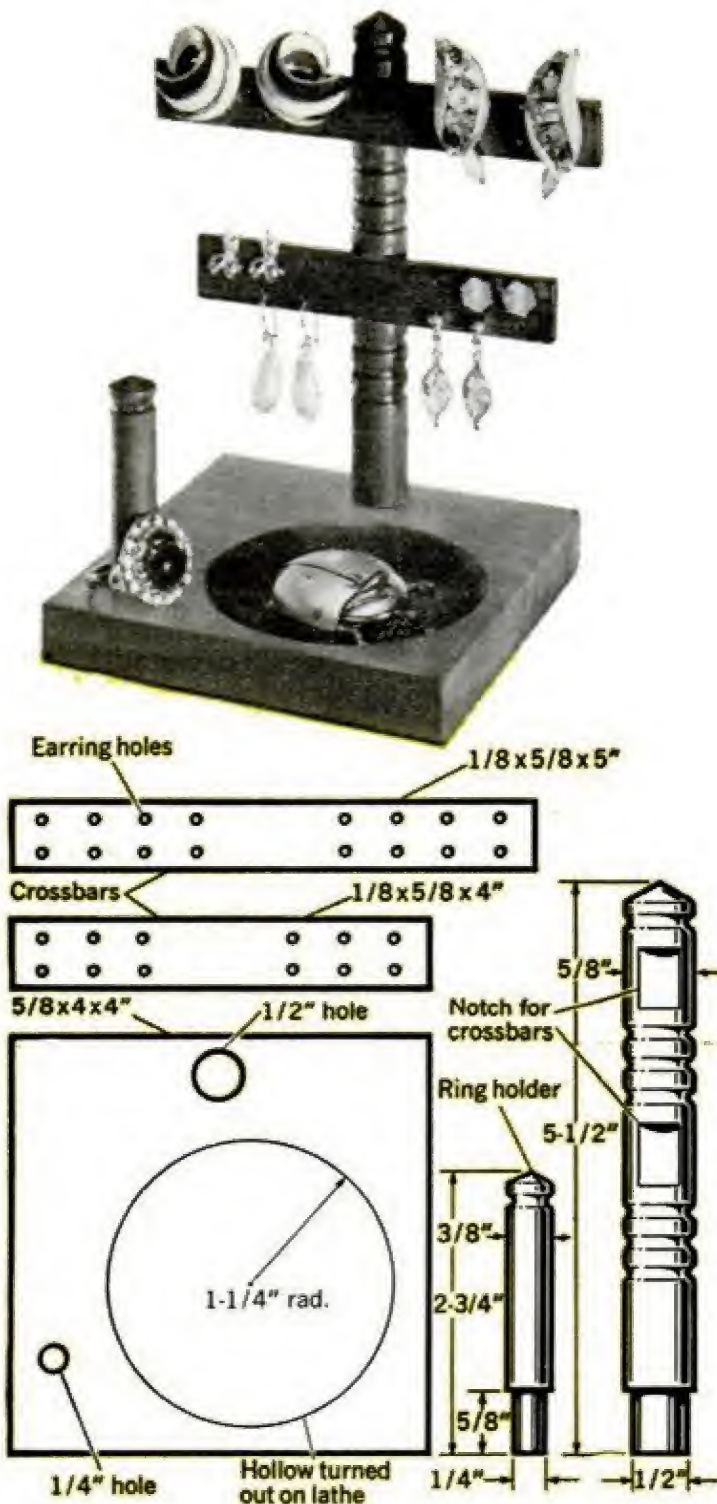
The "tree" at the back keeps the earrings in pairs: the clamp types on the crossbars, and those for pierced ears in the small drilled holes. Rings are neatly stacked on the short pole at front and pendants and pins can be stored in the scooped-out portion of the base.

I recommend using hardwood, such as walnut. The two posts and the dished-out section are turned on a lathe (the latter on the lathe faceplate).

Sand the turnings on the lathe, using a fine-grit sandpaper before making the cutoffs. Then assemble the stand using glue, and let dry.

Finish with a coat of stain and wipe off the excess. Allow the keeper to dry for 24 hours, and apply wood paste filler. (This is necessary only if you used an open-grain wood such as walnut, mahogany or oak). Finally, spray on two coats of clear lacquer. After a two-week "curing" period, bring the piece to a hand-rubbed luster using double-0 steel wool and Butcher's wax.

—Harold Jackson



A Baffling Puzzle

Here's a puzzle that you—and no one else but you—will be able to solve unless you reveal its secret. Made as shown in the drawing, the smaller piece (with the dowel glued in) fits into the larger one. The object is to engage the notch in the rubber band which appears to be in the large piece.

The illusion that *you can* engage a rubber band is created by the way you withdraw the smaller part. To

Make for the Fun of it

Key House Number

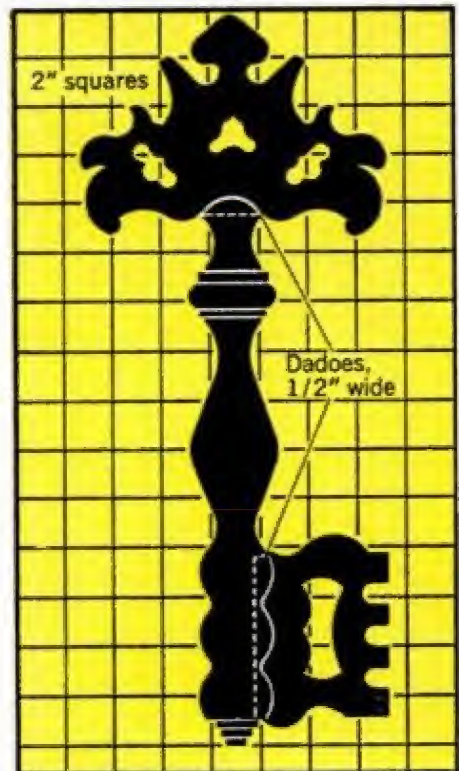
Looking for a novel way to display our house number, my wife and I hit on the idea of making a replica of a keymaker's sign. It's easy to make, and when it's hung from the roof overhang, the early American touch enhances the look of the house.

The turned section is six glued-up 1x5s. While this piece is "square," cut the two 1/2-in.-wide dados for the handle and key sections. Then cut two blocks to fill the dados and glue them in place with water-soluble glue and use paper in the joint. Next, the turning is made. After completing the lathe work, the glued-in blocks can be easily pried out with a slight dampening and a chisel. Sand the turned section and set it aside. Now jigsaw the decorative handle and key sections and, after sanding the edges, glue these pieces in place on the turned section with waterproof glue.

The house numbers are jigsawed from 1/2-in. stock and are glued to a 3/4-in. mounting strip fitted with screw eyes to accept the chain as shown. All parts are then assembled with a decorative chain. Though expensive, a solid brass chain is the best choice. But, if you prefer a less expensive chain, you can paint it with flat black enamel.

To finish, stain or paint the key to suit your home's exterior. If you prefer, the key can be antiqued (make distress marks with gouge, chisel or by beating with a chain). Since the key will be exposed to the weather, apply at least two coats of exterior varnish for maximum protection and long life.

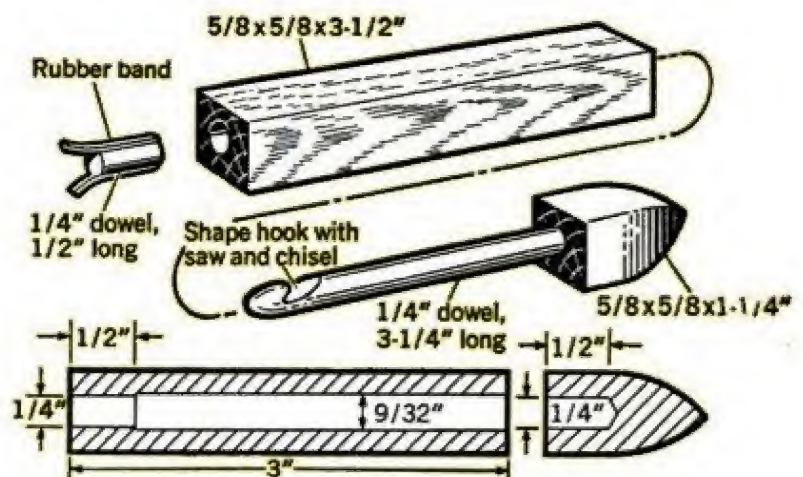
—C. Wayne Close



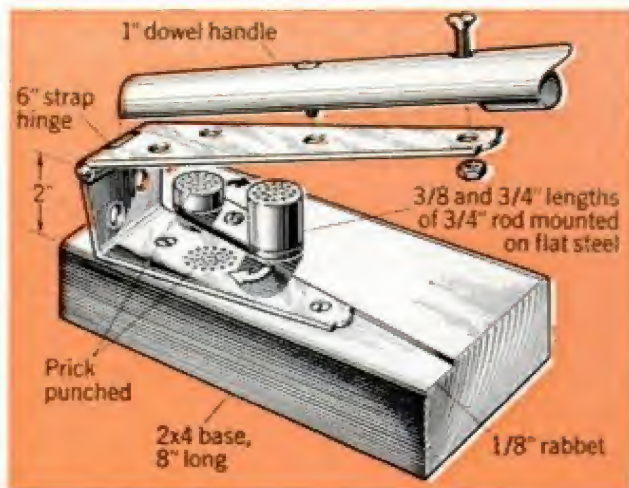
pull off the gag, you slide the plunger out an inch or so by gripping the tapered end between thumb and forefinger. Then, when you squeeze it, it will snap from your fingers and literally fly back into the block. Then, pass the puzzle to a challenger and sit back and watch as he finds it impossible to hook the band as you seem to do so effortlessly.

It's important to be sure that the ends of the "rubber band" are clearly visible when the dowel is inserted.

—Kenneth Wells



HINTS FROM READERS



Nutcracker made from strap hinge

Here's a small item you can turn out by the score for fun or profit. The nutcracker is simply a 6-in. strap hinge with one leaf bent at a 90° angle at a point where it will take the largest nut. The "turret-head" feature is simply two different lengths of 3/4-in. rod epoxied, or soldered, to a short section of flat metal that flips into position to handle various-size nuts. Finish the 2x4 base as desired and, if you would like to introduce a personalized note, why not rout in or burn in the recipient's initials?—*William Waggoner*

Emergency resistance-wire repair

When the resistance-wire coil on our toaster burned in two, I used a brass tube from a ballpoint pen to fix it. Simply cut a short length of the tube, insert the burned-off ends of the wire in each end of this tube and crimp them with pliers.

—*G. R. Boulden*



Rest before driving

Here's one way you can beat fatigue while waiting for an opportunity to tee off or for a slow foursome to clear the green ahead. It's an inexpensive campstool that's attached to your golf cart by means of two strands of rubberized rope that are looped through the legs and fastened to a cart member. Use a length of 1/4-in. threaded rod through two of the legs at the bottom to insure stability, and mount a metal clip on the cart-bottom to secure it when the stool is folded.

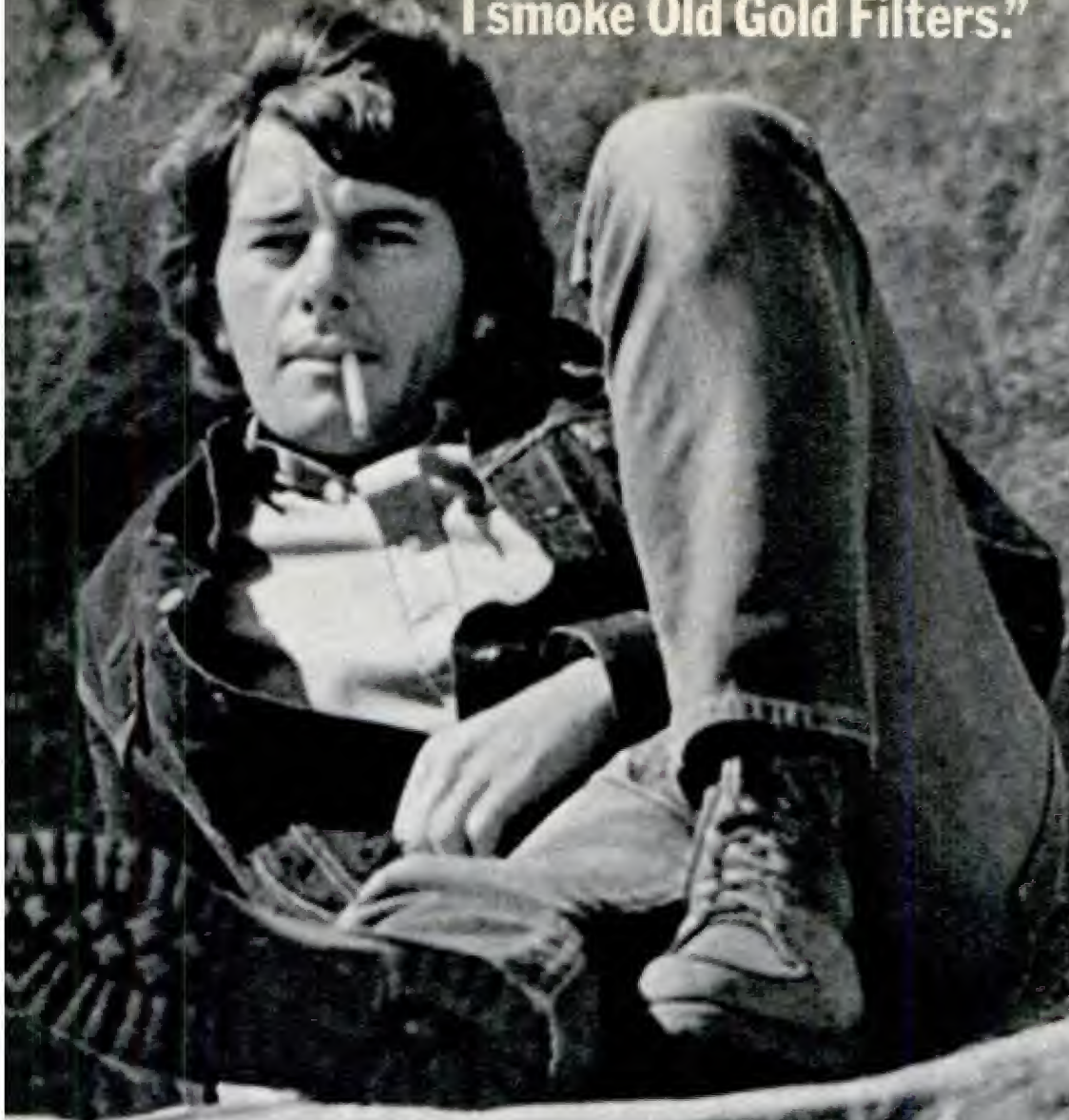
—*William Waggoner*

String-marker spaces fenceposts

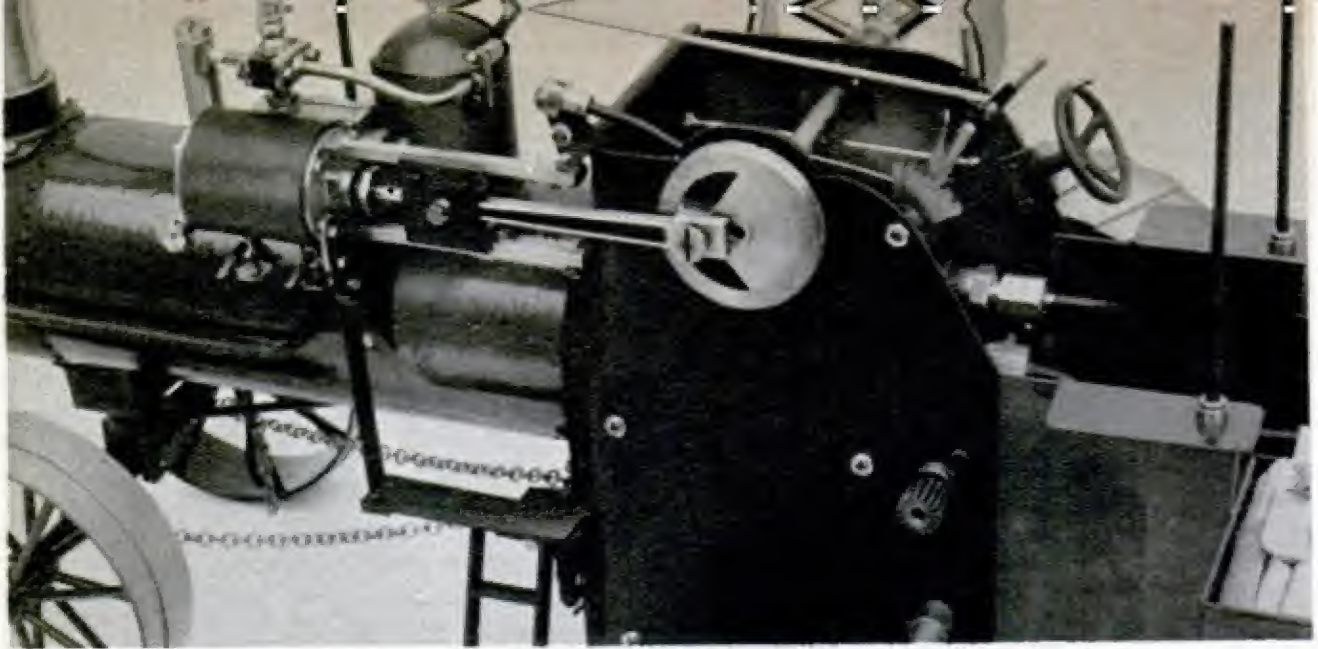
For a low-cost way to insure equal spacing between fenceposts, without constantly measuring, try marking the desired intervals on a length of mason's line. If you use a red felt-tip pen, the post locations will be easier to spot.

—*Herbert E. Serold*

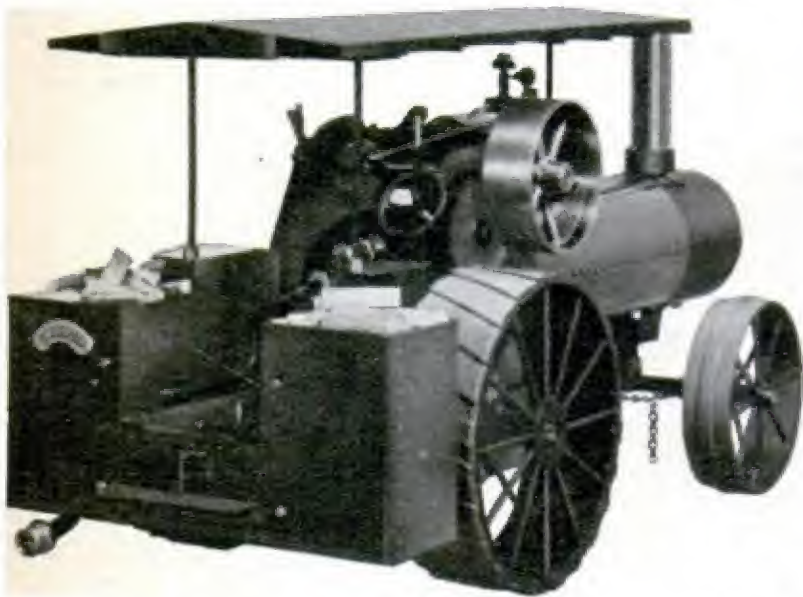
1971 L8-111118
"I want to taste the tobacco in my cigarette.
I get what I want.
I smoke Old Gold Filters."



Old Gold Filters. The cigarette for independent people.



TWO GEARS are used on model's left side. Notice the connections leading from steam dome to cylinder



WITH FIREWOOD stacked in the fuel bunkers, model appears ready to roll. The unit is actually fueled by alcohol

MODEL STEAM TRACTOR

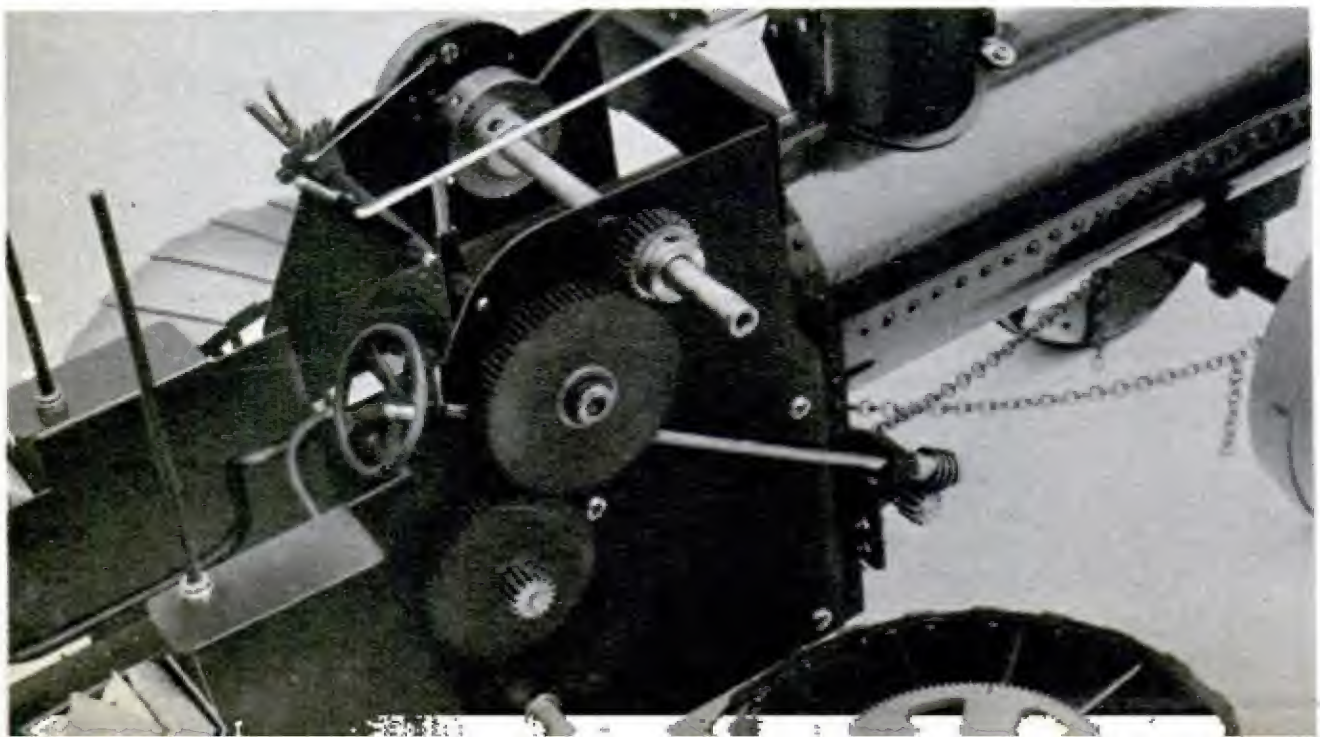
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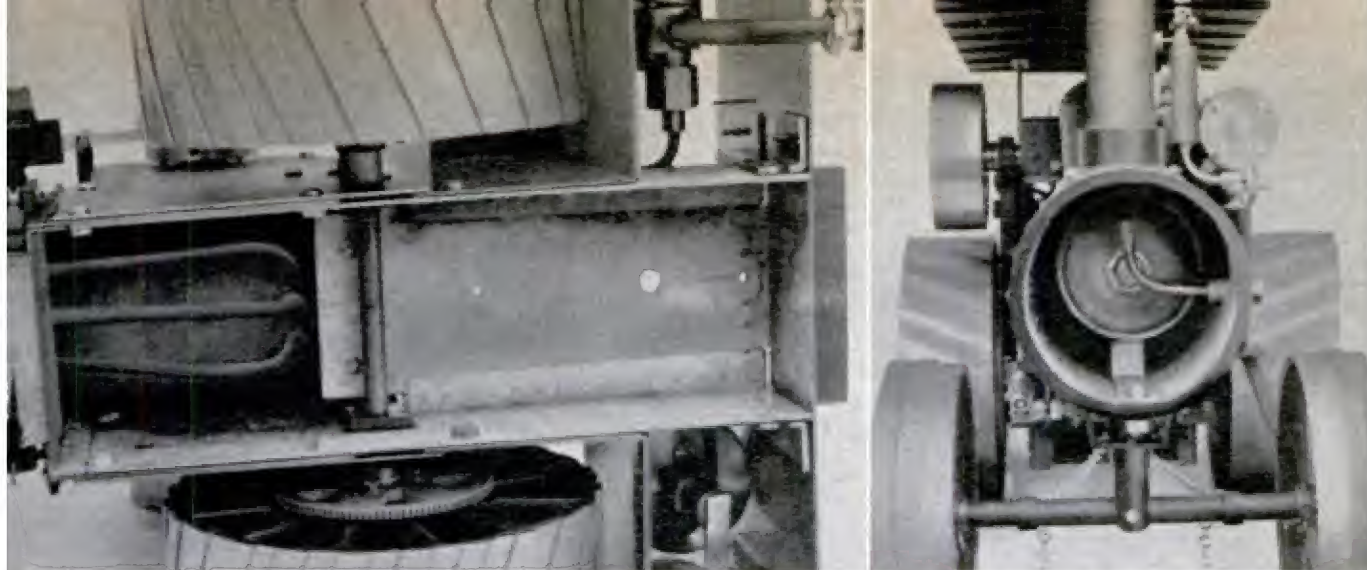
nominal 2-in. steel water pipe makes a good boiler outer casing. The pipe wall is thick enough to give good depth of thread for bolt-on components and more than adequate to meet strength requirements.

Power transmission. Nine gears are used: seven spur gears to move power from the crankshaft to the rear wheels, and a worm-and-pinion for steering. *Ed. Note:* Since many will want ready-made gears, rather than make their own, the full-scale plans tell where to buy commercial sets.

The valve gear fitted to the tractor, generally called the slip-eccen-

GEARS on the right side transmit power from the crankshaft to rear wheels. Note the slip-eccentric gear





UNDERSIDE of model, with the fuel tank and burners removed, details how plate work at rear is assembled

tric type, is a relatively simple arrangement that lets the engine run either way, while requiring but one eccentric.

For adequate strength, all attachments to the cylinder should be silver-soldered. Before you start, all parts must be scrupulously clean so the solder will flow into the joints. Follow standard soldering practice; use emery cloth to clean all surfaces to be joined and be sure the mating parts are a close fit because you cannot build up a fillet with silver solder.

The canopy. Built of $\frac{3}{16}$ -in. plywood, eight ribs hold the two canopy halves securely together. End plates are cut from 22-ga. sheet metal and attached to the roof sections with small nails through pre-drilled holes. Bear in mind that the canopy should be easily removable for access to working parts of the engine should it ever be necessary to engage in a little repair work.

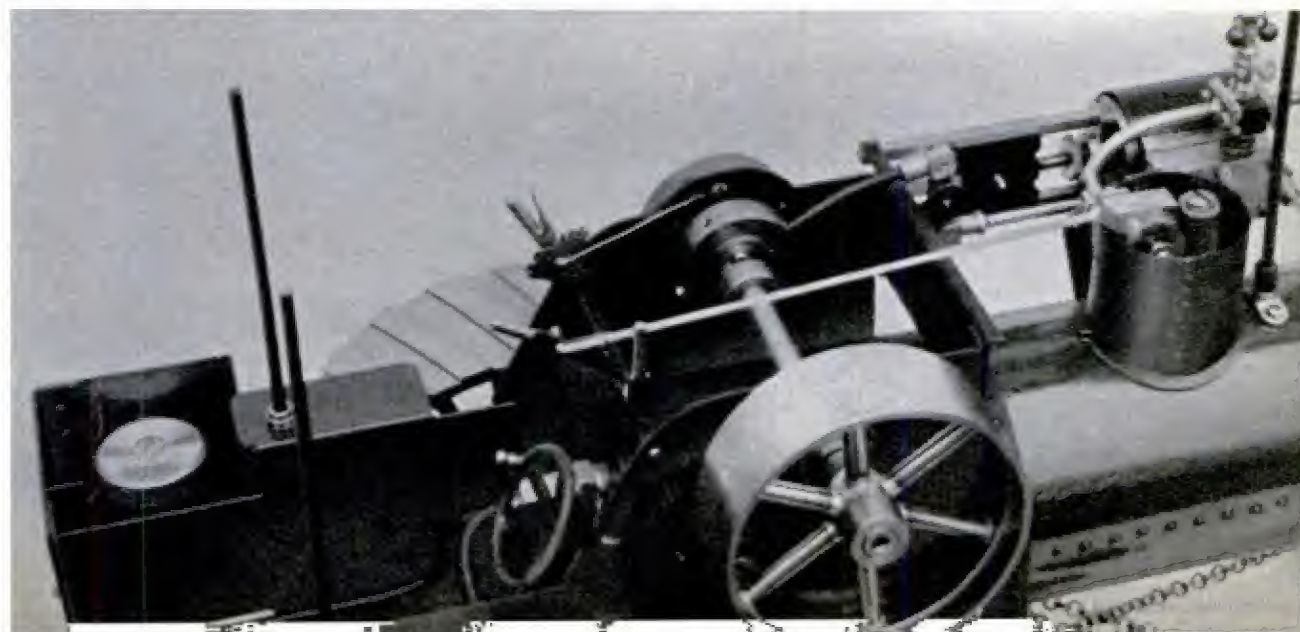
To finish. Dummy piles of firewood fitted to the fuel bunkers add a realistic

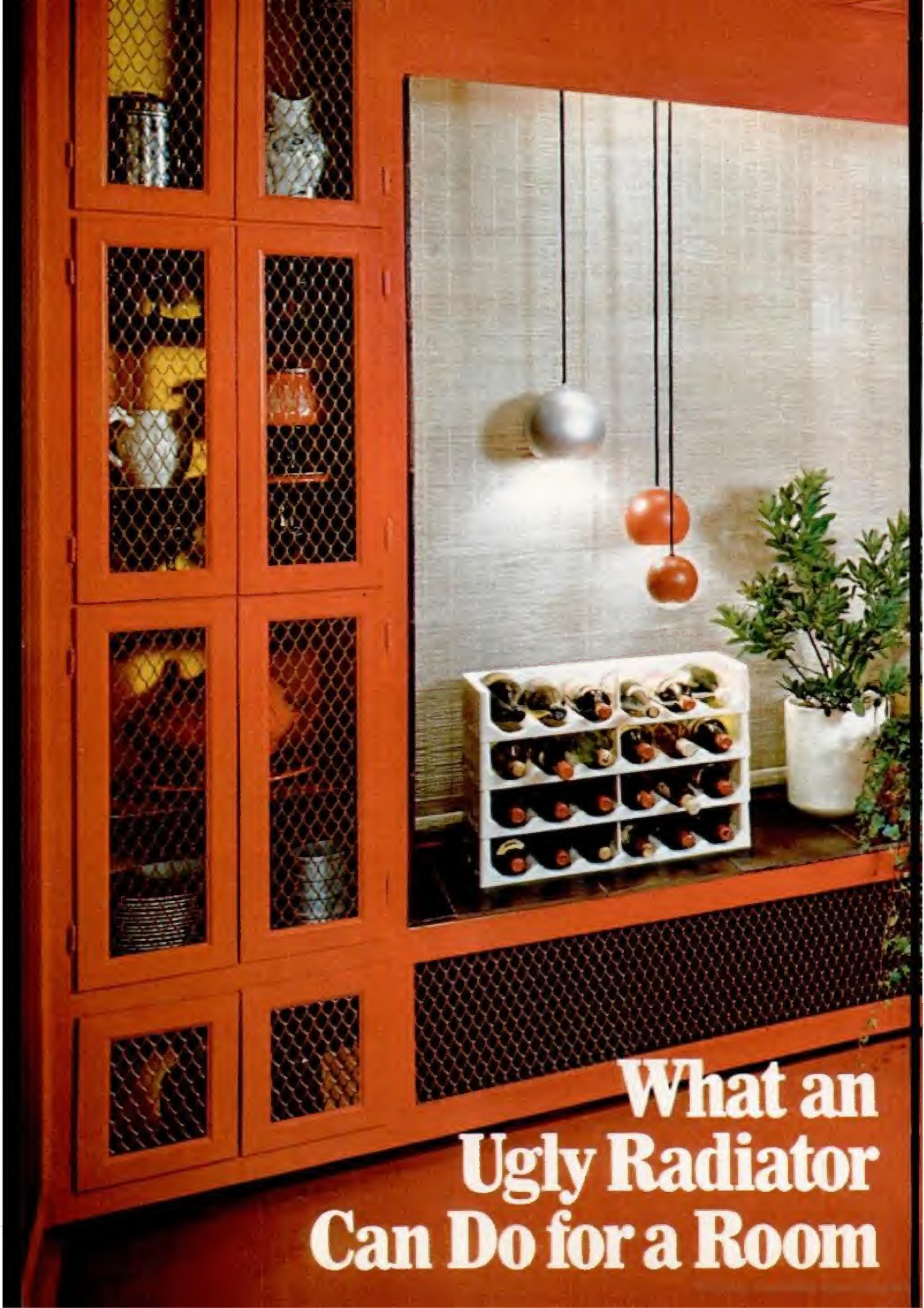


BEST HEATING will be obtained when the burners fill the entire firebox with a soft and steady flame

finishing touch. Though just about any paint combination will look well, it should be mentioned that at the height of their popularity most steam-traction tractors were painted black or green. Thus, my choice of finish ([see color photo, page 95](#)) is accurate and good to copy. ★★★

DISPLACEMENT LUBRICATOR supplies oil to inner "works" of cylinder. Small valves are for let-off

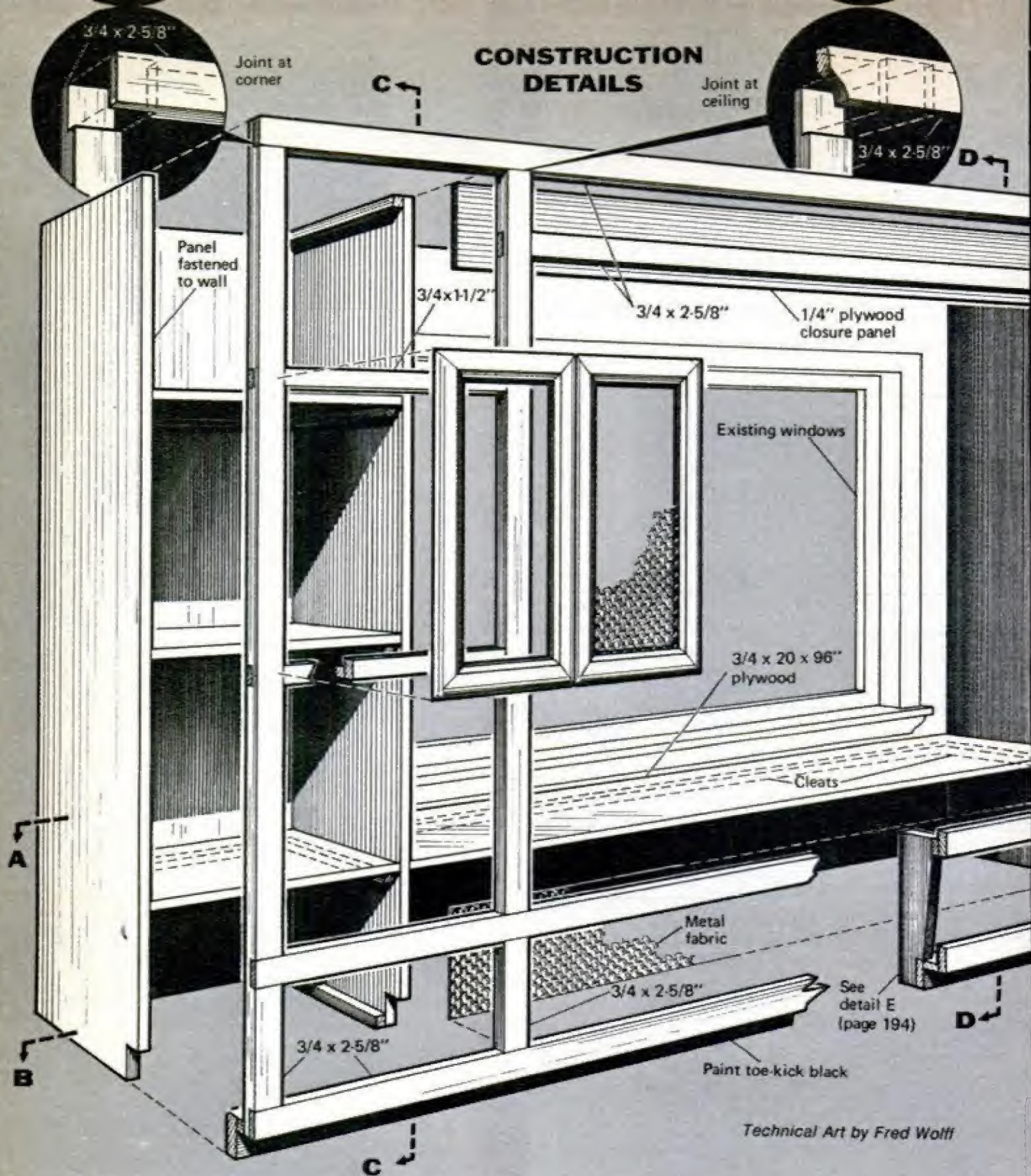




What an Ugly Radiator Can Do for a Room



PLEASE TURN PAGE



How would you conceal a radiator and make use of the wall space around it? Here's one handsome wall-and-window treatment that 'makes' the room

By WILLIAM E. SCHREMP

Color Photo by Bill Maris/Styling by Robert Loigren

OLDER HOMES, in many cases, have two problems in common: 1. Protruding, hefty radiators that contribute a boiler-room look, and 2. a lack of storage space to handle the needs of today's busy family. Happily, with some careful plan-

ning and a little imagination, you can solve both problems with one project.

The attractive, functional wall on the preceding two pages started out as such a problem. The radiator was (and still is) beneath the double-mullion windows and

3/4 x 1-1/2"

1/4" quarter-round molding

Joint at wall

3/4 x 2-5/8"

Shelves, 3/4" plywood

3/4 x 20" panels. Length cut to suit floor-to-ceiling height

Shelf cleat

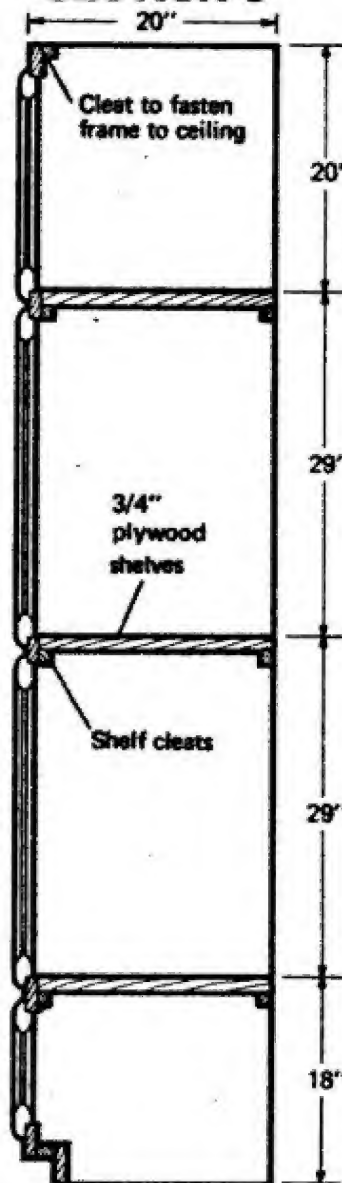
A

B

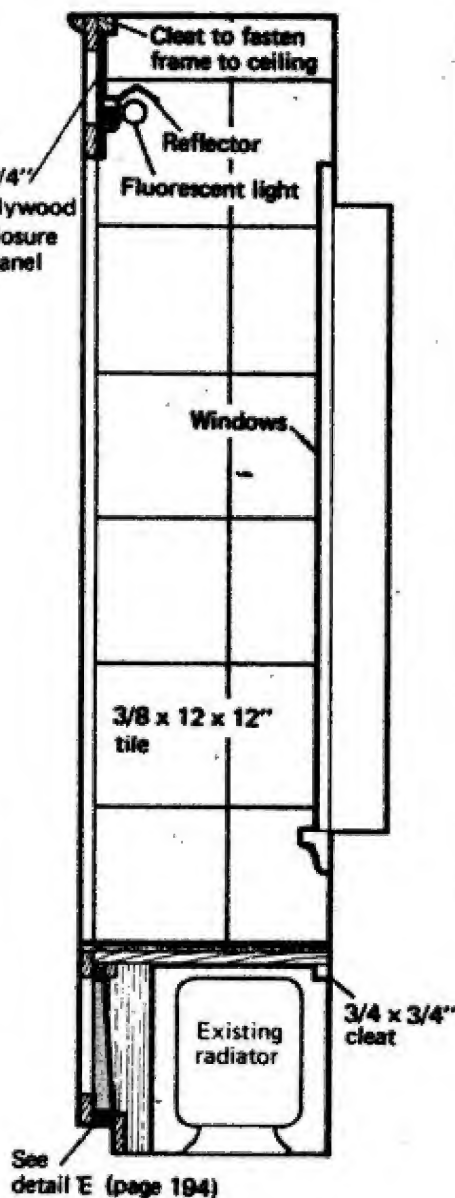
Joint at window seat

3/4 x 2-5/8"

SECTION C



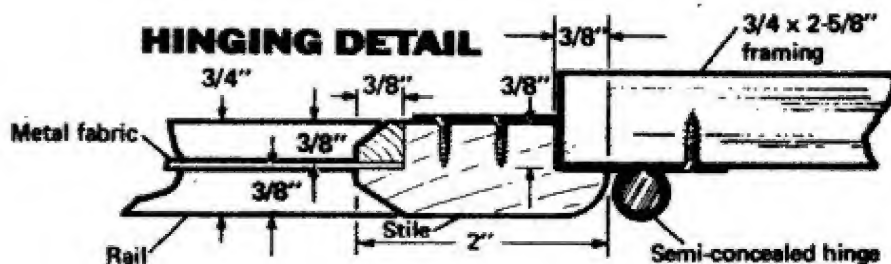
SECTION D



See hinging detail

See detail E (page 194)

HINGING DETAIL



—as is usually the case—it's centered on the wall. The result was wall space which left little choice when placing furniture, plus a dust-collecting heat source which was a nuisance to clean.

Since the built-in shown occupies one end of a dining room, the radiator enclosure was built at window-seat height from wall to wall. And the cabinets flanking the enclosures were built extra deep to provide ample storage for glass-

ware, dishes and games used when entertaining.

The window seat, which covers the radiator, serves as an indoor garden. It's lit from above with special bulbs for growing indoor plants. And for protection against moisture, I lined this space with 12-in. ceramic tiles.

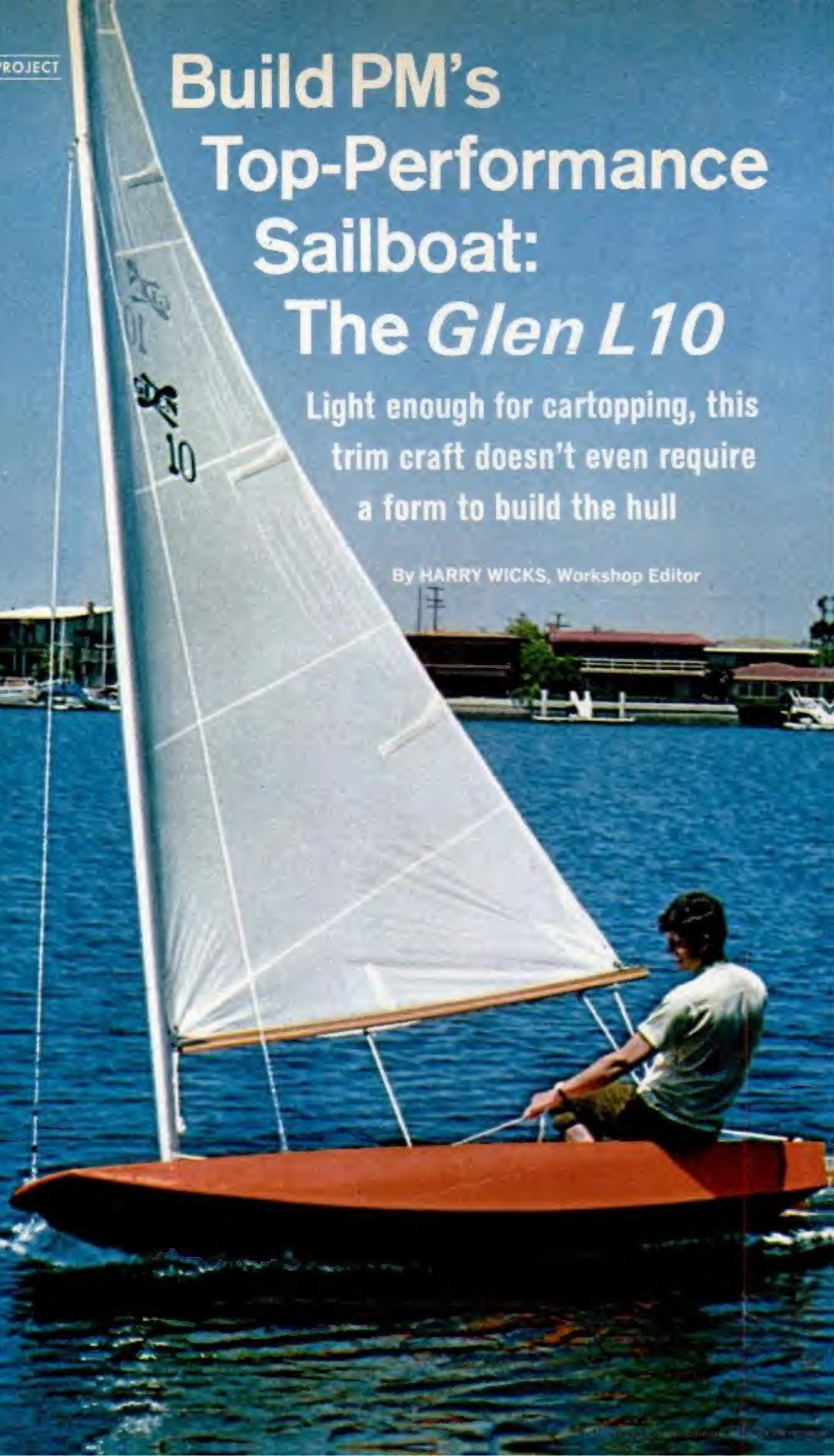
Hiding the radiator. To allow free circulation of the heated air, the radiator

(Please turn to page 194)

Build PM's Top-Performance Sailboat: *The Glen L10*

Light enough for cartopping, this trim craft doesn't even require a form to build the hull

By HARRY WICKS, Workshop Editor



IF YOU'RE a sailing buff you'll spot this trim craft as a pure fun boat. Take her out on a breezy day, and it's almost a sure bet that it will be hours before you'll want to return to the dock.

Designed by Naval Architect Glen L. Witt, the Glen L 10 is a cat-rigged, daggerboard sailboat that weighs less than 90 lbs., making it a natural for cartopping or station-wagon hauling. The mast is light enough to be stepped by one person, and the standing rigging consists simply of forestay with turnbuckle and two shrouds with stay adjusters.

The craft will easily accommodate two adults and perform beautifully; she comes about readily and points well. The designer says that in light air she seems to outperform most boats her size. And in heavy air, she is guaranteed to provide thrills though it does require hiking out to windward and keeping passenger weight as far aft as possible.

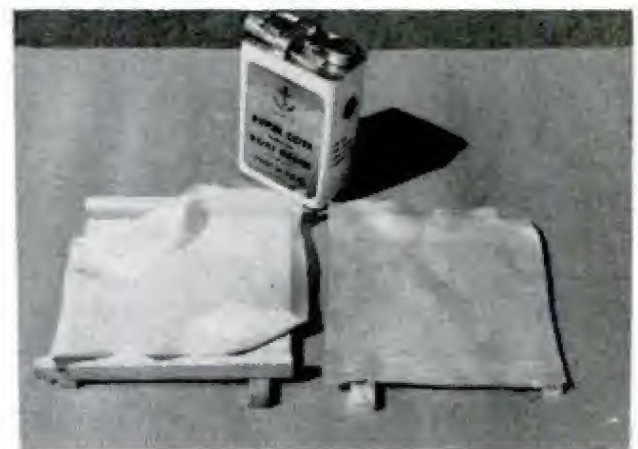
Since total weight is the prime concern when building a small boat that is intended to give top performance, Witt utilized $\frac{1}{8}$ -in. plywood for the most part when he designed the boat. It's possible that in many areas it will be difficult to purchase marine plywood of that thickness. But the boat can still be built of one of the more commonly available plywood thicknesses ($\frac{3}{16}$ or $\frac{1}{4}$ in.); the hull will just weigh more.

All joints in the construction of the boat are made using a hard-setting glue—either plastic-resin or resorcinol. And the designer recommends using either hot-dipped galvanized or bronze fittings. The second is superior, but, of course, costs considerably more than the galvanized. Witt makes a point of not advocating plain brass because of its tendency to fracture under stress.

Assembly. Since no building form is used, assembly sequence is extremely



BREEZY-DAY SAILING calls for keeping the weight as far aft as possible. Two people make this a snap



DAGGERBOARD TRUNK is fiberglassed inside before assembly. Below: Bed logs must be carefully aligned



PLAN AND PATTERN INFORMATION

PM PLANS. Complete plans plus instruction booklet for the Glen L 10 are available by sending \$7.50 to Popular Mechanics Boat Plans, 224 W. 57th St., New York, N.Y. 10019. To order, specify Glen L 10 Boat Plans No. B 1265.

PATTERNS. If you prefer, you can obtain the plans and instruction book (above) plus full-size cutting patterns for the stem, daggerboard trunk, rudder, tiller, transom, frames, stem and side planking. To order this complete package, simply send \$11 to Glen L Marine Designs, Dept. PM, 9152 East Rosecrans, Bellflower, Calif. 90706.



PLANKING-SHEER-CHINE fits into bow-piece notch. Notice plywood members fastened to the underside



KEEL IS PRECUT to fit over the daggerboard trunk. Both ends are left oversize for custom fitting



BOAT CAN BE BUILT on two sawhorses with top members parallel; use cord to hold the side planking



GLUE IS APPLIED and keel is sprung into position. Use clamps to hold forward deck-beam blocking



FAIRING is started by filing a series of equally spaced grooves all along the stem, keel and chine



YARDSTICK is used to simulate planking which must rest on both keel and chine and not just one edge

important. Actually, the precut side planking is used to hold the various frames in their relative positions. Each of the frames and the transom must be carefully fit to the side planking by cutting the notches in the frames to fit the assembled side planking with sheer clamp and chine logs attached.

Fairing. All of the framework must be beveled or faired so that the plywood planking will rest on *all surfaces* and not just one edge. Along the forward part of

the chine, a considerable amount of beveling is necessary. In the long run you'll save time (and your arms) if you sharpen your plane-iron before tackling the beveling operation.

Three $\frac{1}{2}$ x $1\frac{1}{2}$ -in. battens are used on either side of the centerline. They're fitted into notches in the transom and rest at the designated position on frame No. 1.

To finish, Witt recommends trimming the hull and filling all imperfections with

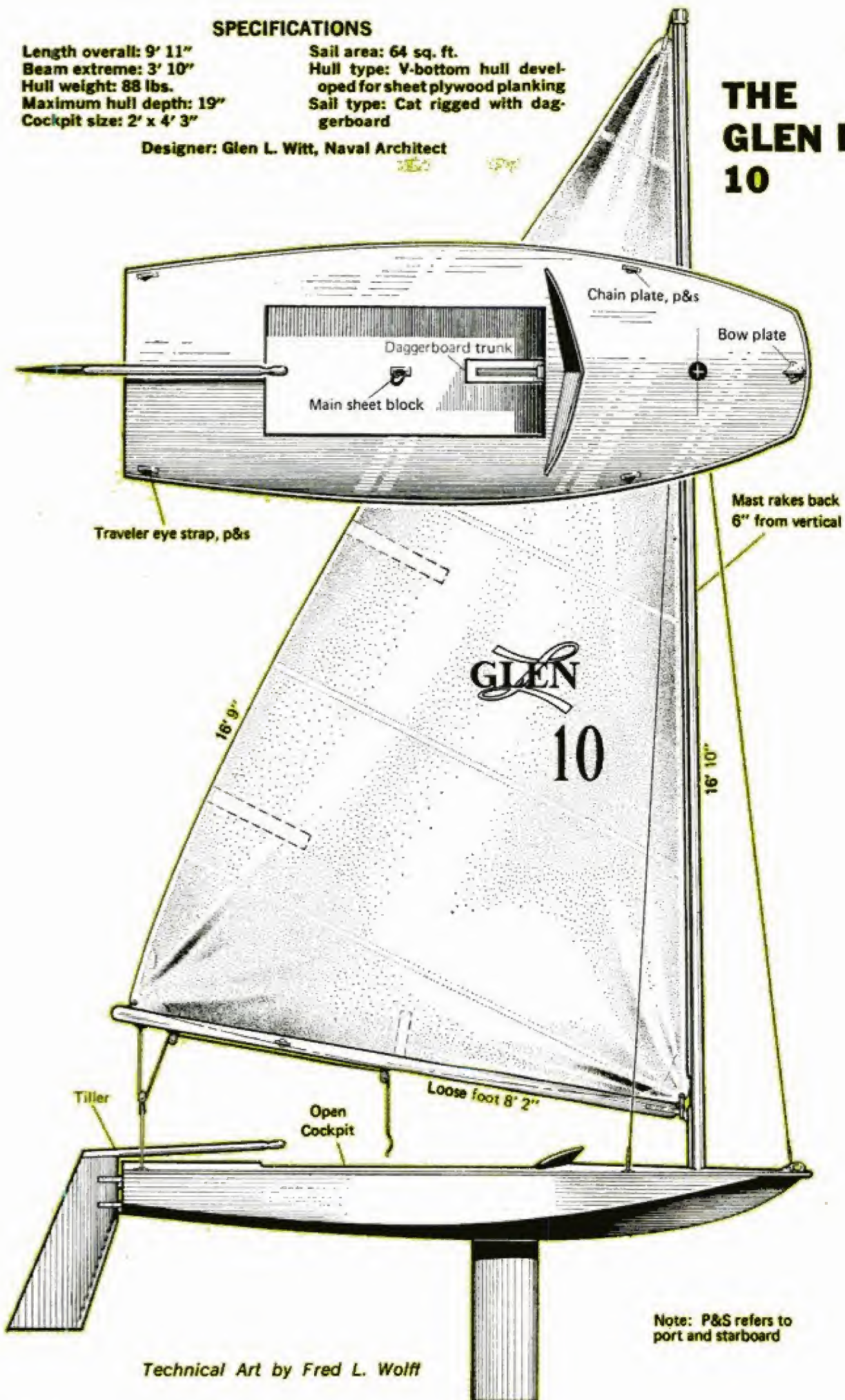
SPECIFICATIONS

Length overall: 9' 11"
Beam extreme: 3' 10"
Hull weight: 88 lbs.
Maximum hull depth: 19"
Cockpit size: 2' x 4' 3"

Sail area: 64 sq. ft.
Hull type: V-bottom hull developed for sheet plywood planking
Sail type: Cat rigged with daggerboard

Designer: Glen L. Witt, Naval Architect

THE GLEN L 10





AREAS BETWEEN GROOVES are removed in a smooth, sweeping curve to eliminate any humps or dips



GOOD METHOD of insuring a smooth fairing job on aft section is sandpaper glued to a length of 2x4



BATTENS ARE NOTCHED into transom and rest on the frame. Next, bottom panel is trimmed in place



BUTT-BLOCKS are fitted between the battens before the planking is permanently fastened to hull



INTERIOR of the boat should be painted prior to applying the decking. Use a quality marine paint



PINE BLOCKING needed on bow extends from sheer to sheer, must be faired to form crown of decking



DECKING is butt-joined and fitted to frame in the same manner as bottom planking was accomplished



ALUMINUM ANGLE BRACKET holds cam cleat and the pin on a chain to hold daggerboard in down position

a hard-setting putty. Fiberglassing the hull is optional, but if you do decide to do it, it should be put on the bare wood with a 6 to 8-oz. cloth used with resin. Make certain you follow the manufacturer's application instructions on the can.

Most step. Two types of mast steps are detailed in the plans. But if you prefer, a

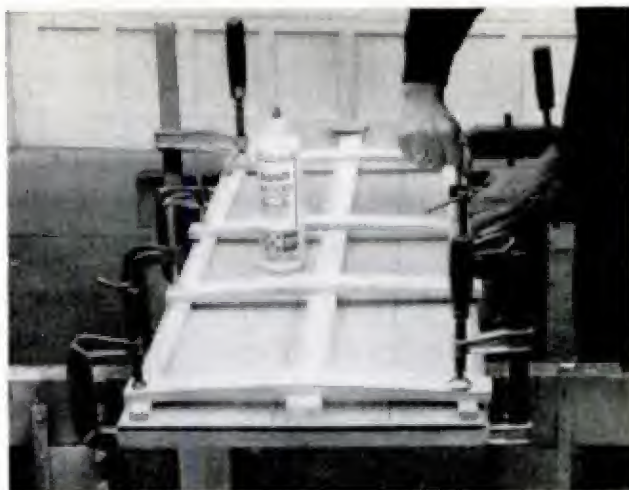
cast-aluminum type can be purchased from Glen L Marine Designs for \$6. Additionally, the marine design firm also has a complete line of accessories which have been custom-made for this particular craft. So if you want to get your boat in the water in a hurry, write to the firm at the address shown in the box on page 143 for details and prices. ★★★

HINTS FROM READERS

Apply center clamping pressure

To provide clamping pressure at the center when laminating two or more plywood panels, you can do it with common C-clamps, according to the folks at 3M Co. After spreading glue on mating surfaces, position the panels and run a cleat down each edge and a third, thicker, cleat down the center. Use scrap to span the cleats.

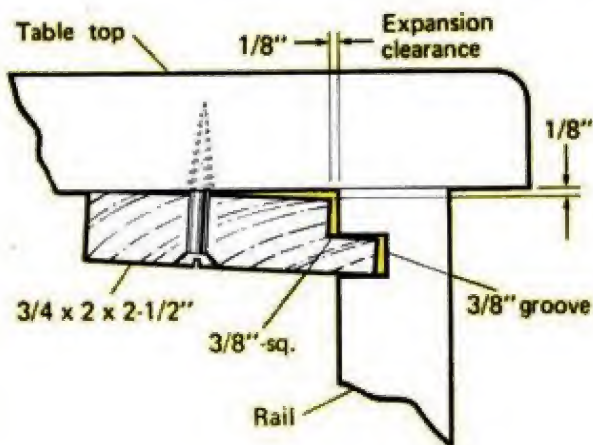
—Bob Brightman



Concealed tabletop fastener

The drawing at right illustrates a method of fastening tabletops I've used for years with great success. The important point to keep in mind is the clearance that must be allowed between table and rail. Also, when installing the fastener, leave about 1/8-in. clearance so that the screw will pull the parts together snugly.

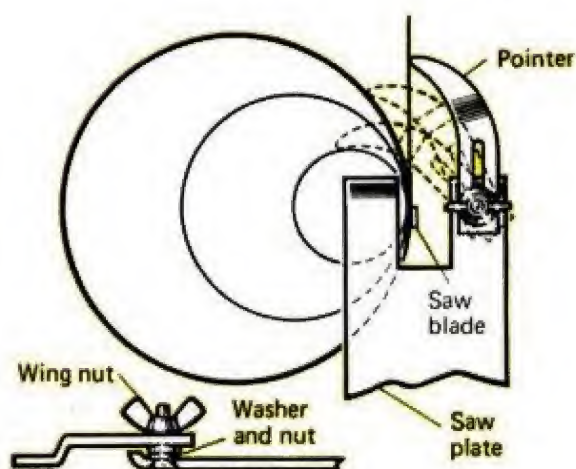
—Harold R. Crawford



Pointer guides sabre saw

When cutting with a sabre saw, most persons find it hard to follow a line free-hand. To make this task easier, I added an adjustable pointer to the saw shoe as shown. Simply start the saw on the line you want to cut, turn off the saw and set the pointer on the line. The attachment will let you make a much neater cut.

—H. C. Anderson



Kill weeds in pavement joints

Unightly weeds growing up out of the cracks and joints in concrete pavement or walks can be killed by squirting a small amount of kerosene on them. Use a squirt-type oil can to get the stream exactly where you want it. *Caution:* Do not use this method around any treasured plants or trees or they, like the weeds, will soon be gone.—Andrew Vena

Add an instant outlet

Needing a receptacle at one end of my workbench, I hit upon the idea of simply splicing into a BX cable strung below a joist and installing an outlet box. After cutting off power, cut the cable and install the box on the joist. You'll find there is plenty of slack in the line to permit the installation. Finish by adding the plate cover.—Bob Brightman





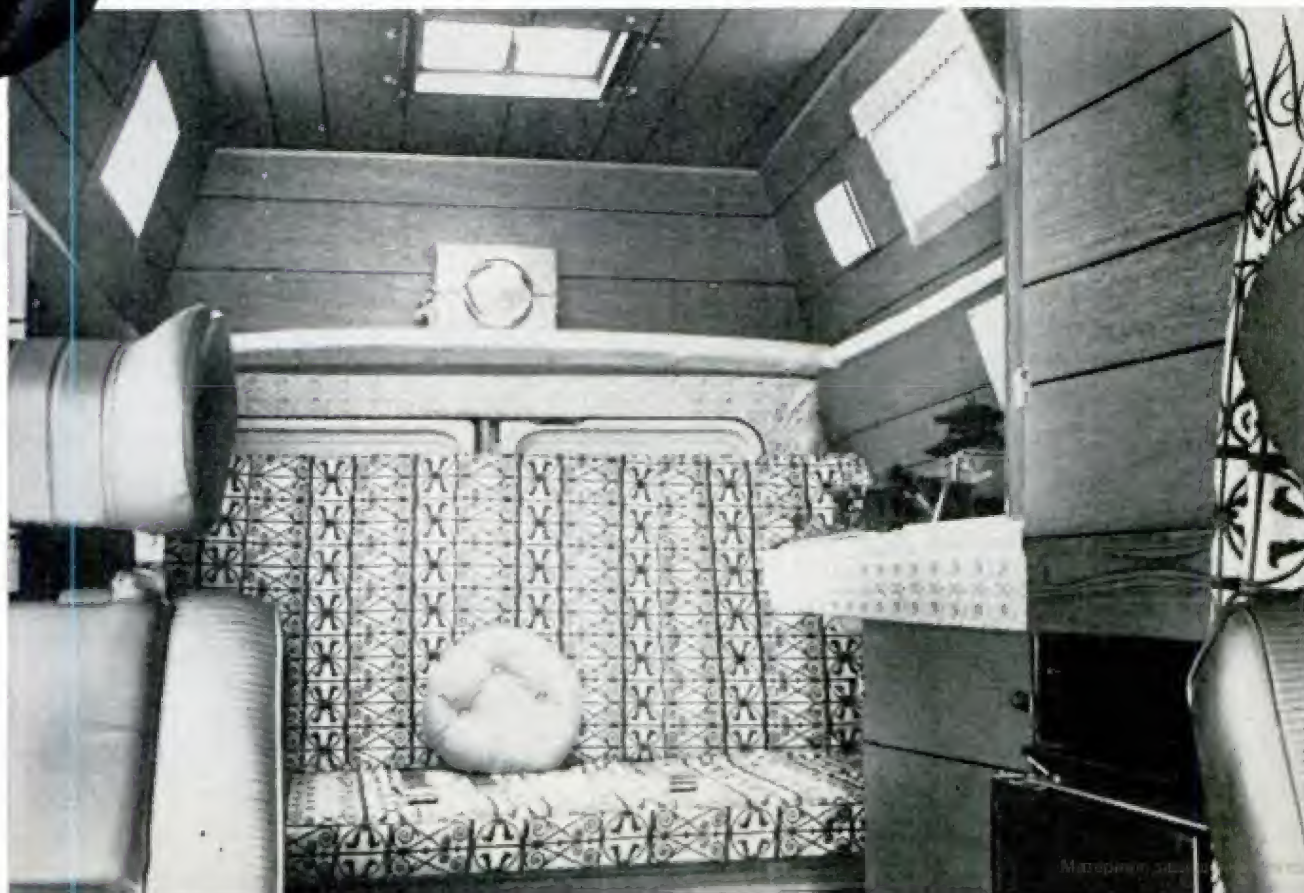
From Van to Camper —\$340

By raising the roof on a Ford Econoline we got a motor home with full headroom. The idea works for a Chevy or Dodge too

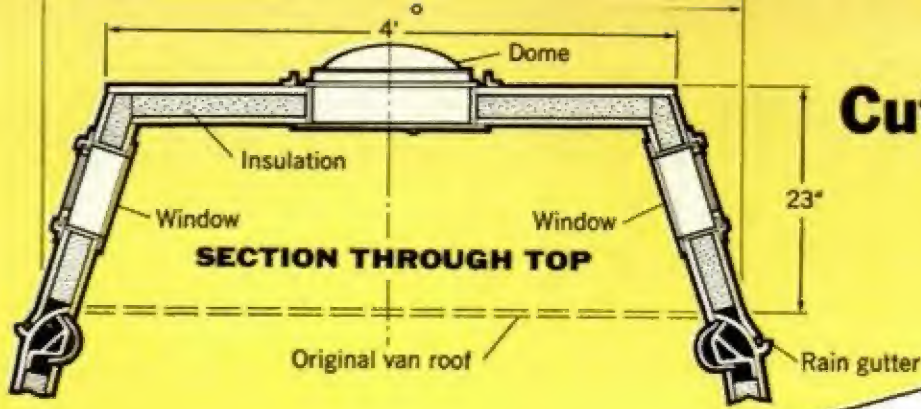
By JEFFREY W. DAUM

LIKE MOST FOLKS who enjoy spending their vacation time traveling, economy motivated our decision to invest in a motor home. But, we soon learned that commercial jobs that would provide the minimum comforts we desired were priced in the neighborhood of \$7000. So instead, we purchased a new Ford Econoline complete with airconditioning. And for a total additional cash outlay of \$340,

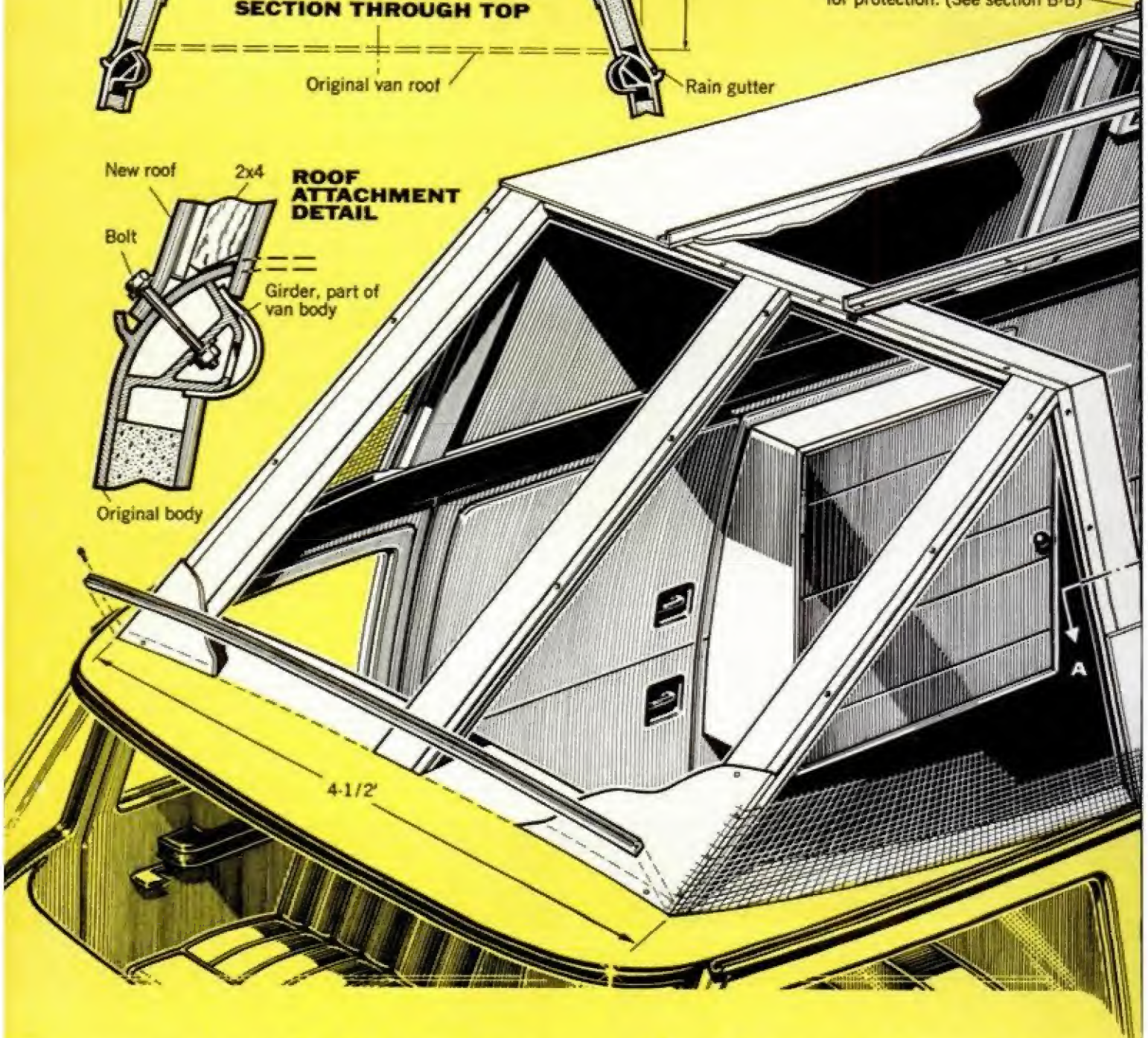
LOOKING TOWARD FRONT of van (two photos at bottom of opposite page), left mid-side shows sink, two-burner stove and refrigerator next to cabinet. Middle photo shows closet and storage area over driver and passenger seats. Below, looking toward rear, bed is in sofa position with two bed-boards stacked under the mattress. Notice the storage area beneath the bed; access to it is via the rear doors. Hinged skylight provides light and ventilation



Cutaway of Roof



Angle iron fastened to roof for protection. (See section B-B)



we came up with *Tumbleweed*, our motor home that cruises at turnpike speeds and is economical to operate.

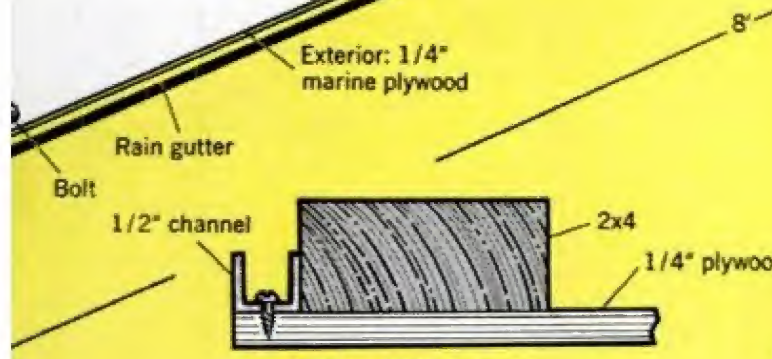
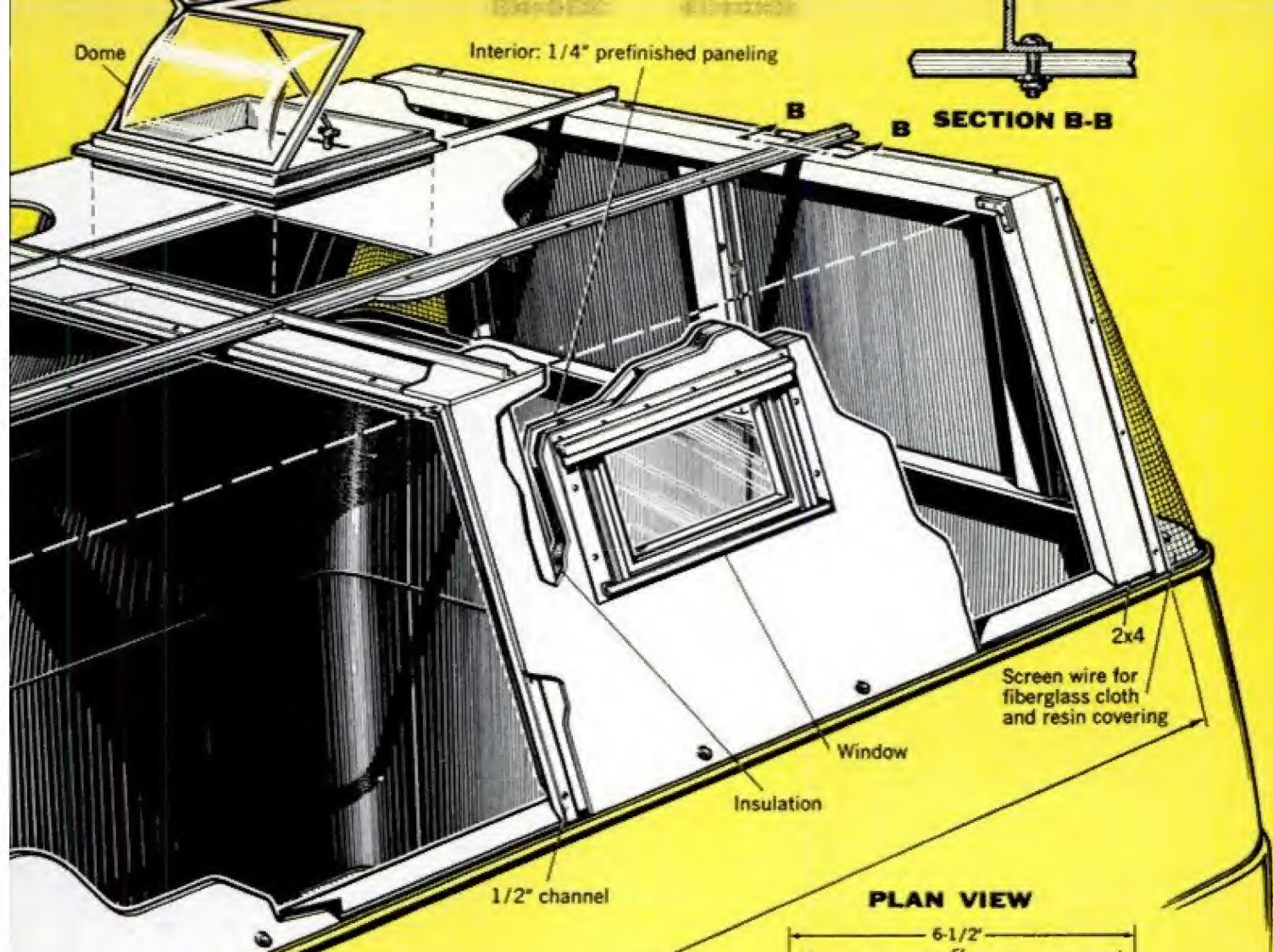
After buying the van, our first step was to take complete interior and exterior measurements. The roof's sloping design minimizes wind resistance and continues the aerodynamic lines of the existing body. The crucial line is the angle of the front of the extension. Here we used the windshield slope to determine the best angle.

In a similar way, the taper (curve) of

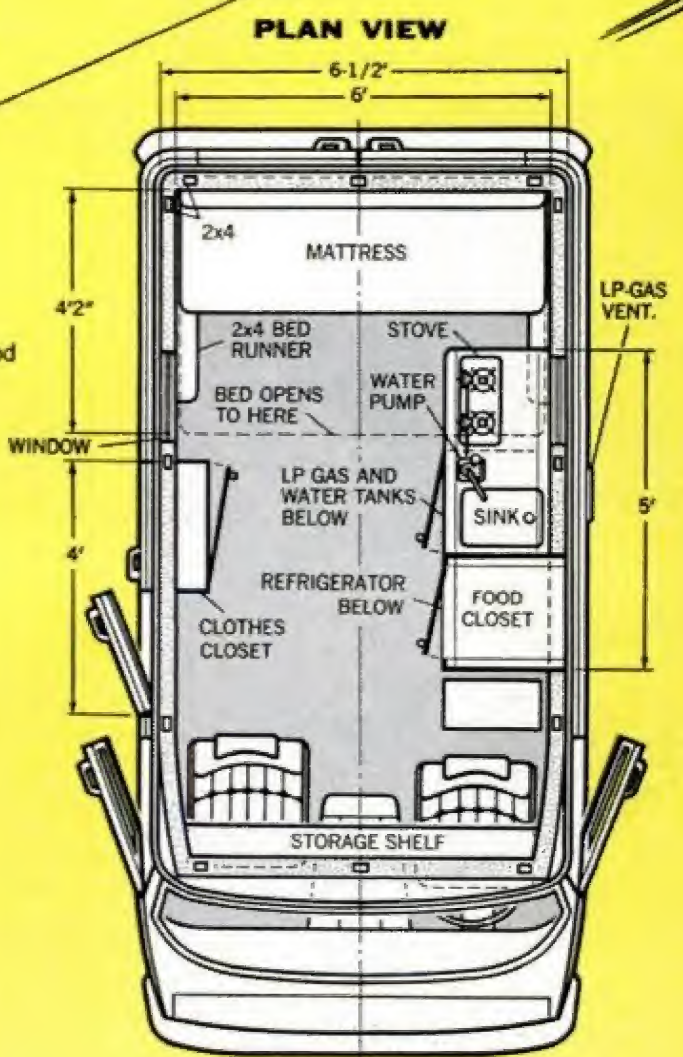
the sides of the van served as guides for the slope of the extended roof sides.

The roof is constructed of $\frac{1}{4}$ -in. marine sheet plywood. Its height can be determined after taking into account the thickness of the insulation and interior paneling that you plan to install.

Each section is fitted with three lengths of $\frac{1}{2}$ -in. steel channel at both ends and in the middle, running across the short length of the section. These are drilled and then epoxied to the inside. The channels in the sides are then bolted to the



SECTION A-A
Technical Art by Peter Trojan



channels in the top, using preformed steel angles. These are bent at the respective slopes determined earlier from existing body lines.

After the roof is bolted together, 2x4s are placed parallel to all the steel channels on the inside. Joints are mitered and then bolted through the roof. These go the full width of the top section but stop 3 in. from the bottom edge of the extension sides, front and back to allow for a flush fit to the body. The 2x4s give additional reinforcement and serve as spacers



RIGHT MID-SIDE showing 2x4 runner which bed rests upon. At top left is door-mounted clothes closet. The portable chemical-toilet fits neatly below

for the insulation and interior paneling material.

The skylight and windows were installed next. These are standard trailer items and come with complete instructions for installation. Finally, a $\frac{3}{16}$ -in. angle-iron brace, 8 ft. long and in the shape of an elongated "H," is bolted on top of the roof to provide protection against falling branches.

The original van roof was cut out down to 3 in. above the rain gutter. The latter must be left completely intact to serve as the ridge on which the extension sits (see [drawing, page 151](#)). Be careful to cover your van seats and interior when applying the torch, to guard against damage from sparks.

Leave the front part of the original roof intact so it can serve as the shelf of the storage area under the sloping front.

The new top should fit snugly into the rain gutter of the original roof. Drill through the base of the new roof at an angle so the drill bit will go through the girder, which is on the inside of the van's original body at that point. Drill in this

(Please turn to page 196)

COMPLETED TUMBLEWEED stands 100 in. high. Louvers on side of van vent the LP-gas storage area

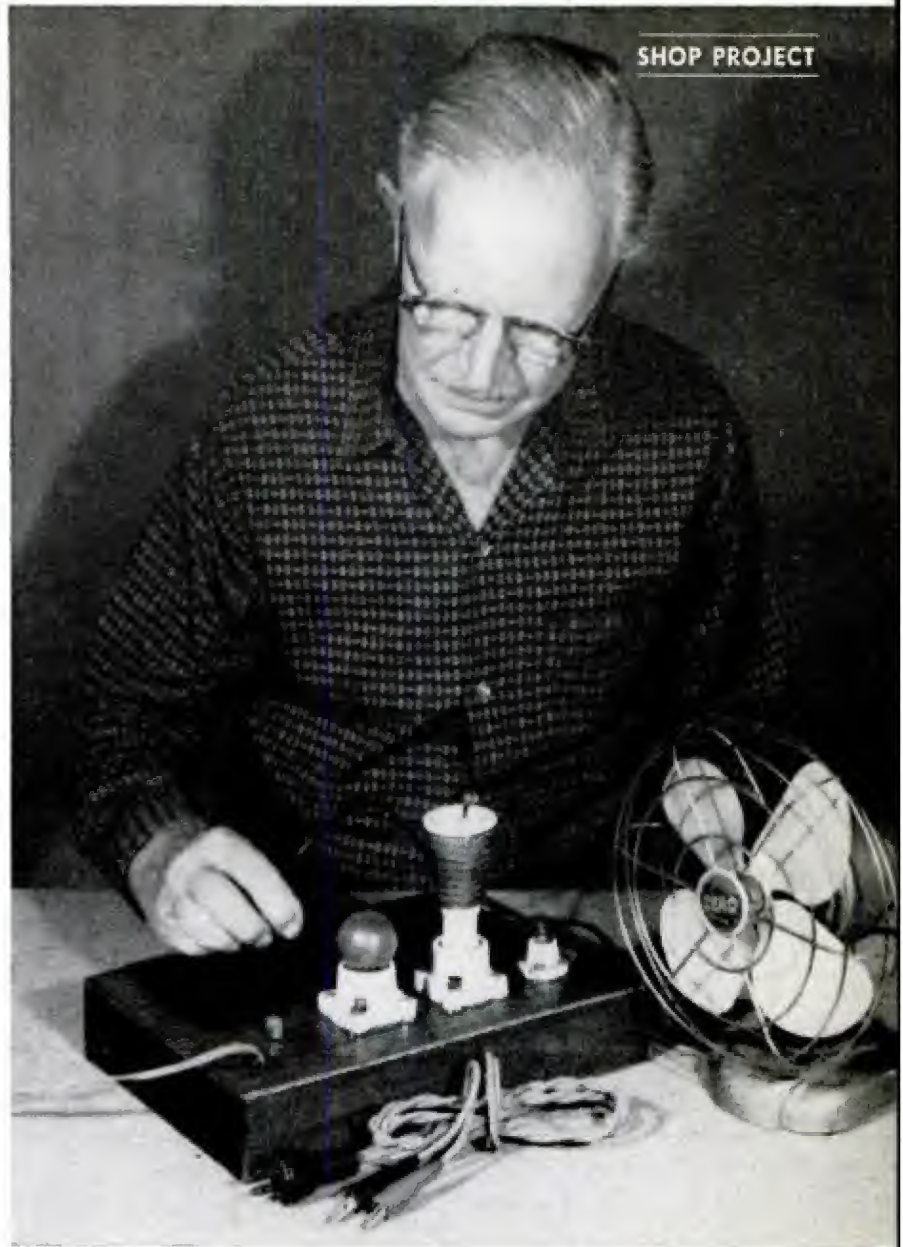


Make This Appliance Test Block

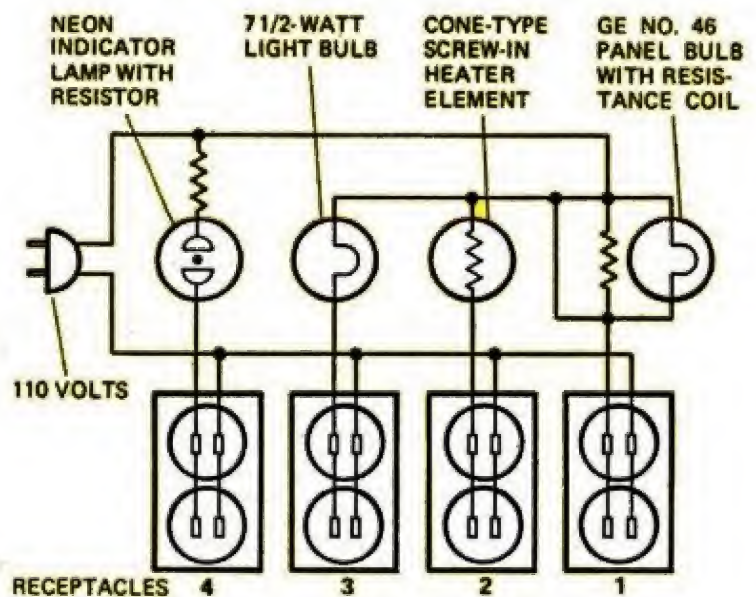
THE SCARCITY of servicemen (and the big bill when you can get one) makes it just plain common sense to be able to do most appliance-testing yourself. You can do it with the test block shown, which offers full line-load with an indicator, series resistor, test lamp and a neon tester for checking voltage leaks.

A 6-v. panel lamp used in series with outlet No. 1 is bridged by about 11 turns of $\frac{3}{16}$ -in. o.d. by .028 resistance wire such as that used in open-coil hot plates. With a high-load appliance such as a waffle iron, which can draw as much as 1200 w., the lamp glows moderately bright.

To test an appliance, first check for breaks in elements and grounds to the case with test leads in No. 3 (a safety test.) Next, plug appliance in the same outlet for a continuity check. Then, plug it into No. 2; if cone heater element glows red, the appliance is shorted; if not, switch to No. 1 and watch lamp to see that the thermostat is cycling if appliance is so equipped.—*W. H. McClay*



TEST-BLOCK WIRING DIAGRAM



TEST BLOCK has four test outlets; text tells the sequence in which to use them. Always check the appliance ground first

HINTS FROM READERS

Sponge-mop speeds car wash

Since neither car washing nor window washing are chores I particularly look forward to, I devised this handy accessory to make those tasks easier. It consists of a viscose sponge, hose connection and length of 1/2-in. pipe. No fancy attachments are needed; just poke a small hole halfway through the sponge and insert the pipe.—*W. H. McClay*



Jig for tightening screw eyes

Next time you have a batch of screw eyes and hooks to install, you'll prevent sore fingers if you make this little jig for turning them in. It's nothing more than two strips of wood taped tightly together, with a separating strip of proper thickness between them. Insert hook in its hole and slip the notch over it to tighten.

—*H. N. Webster*



Continued life for ballpoint case

Next time a ballpoint pen runs dry, instead of throwing it away, save it for future use as a small-tool handle. Just remove filler, pour some epoxy into cavity and insert the tool. The idea works fine for all kinds of miniature tools with shanks and for shop-made screwdrivers and scribes you may make for hard-to-reach locations.—*C. W. Reynolds*



Opener tags along on paint can

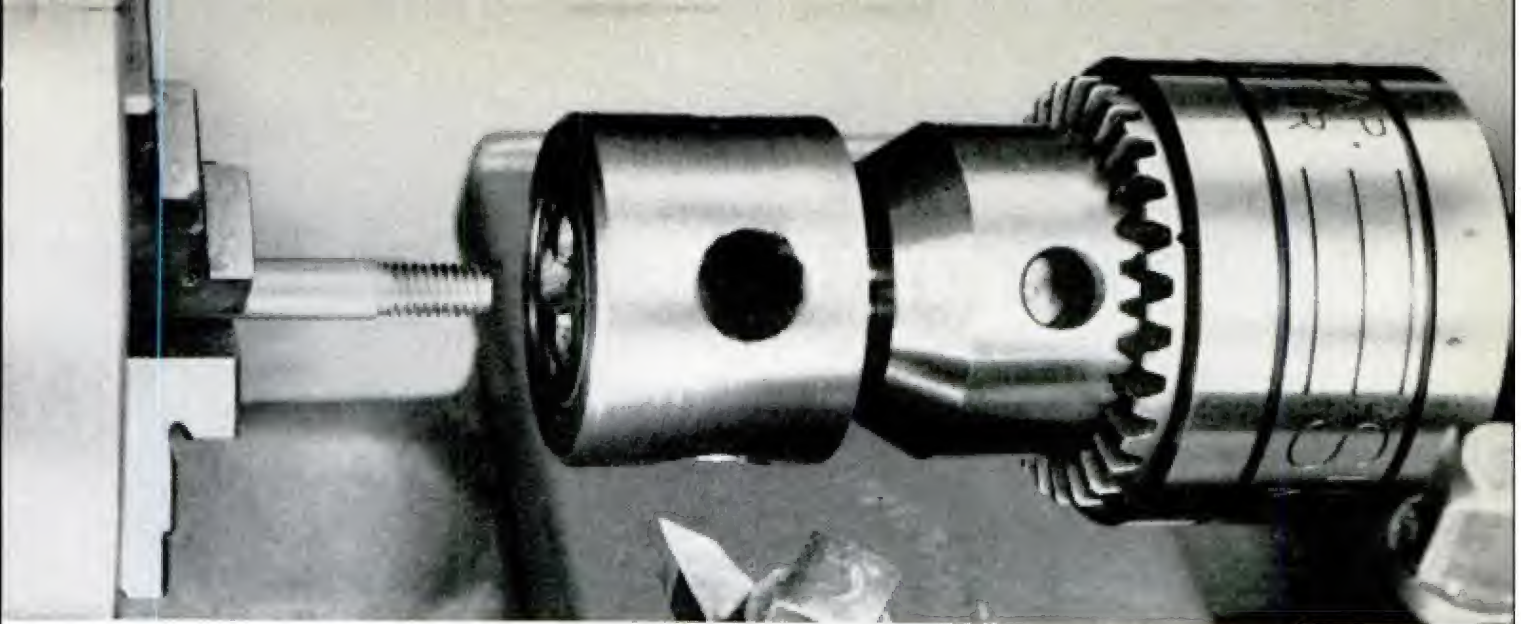
It's time-consuming if you have to set paint tools aside to hunt for an implement when you want to open a can of paint. If you take an ordinary punch-type opener and drill and slot one end as shown, you'll avoid that nuisance. Most openers have a hole at one end, but in either case, saw a slot to the hole so opener can be slipped on and off the bail.



Nut-stop eliminates file jamming

By preventing the large-diameter end of a file from entering the hole, you can keep it from sticking while reaming a hole. Just select a nut slightly smaller than the hole to be enlarged, slip it on the file and tighten it with pliers. If workface must be protected from mars, glue a small piece of felt or rubber to the work side of the stop.





METALWORKING

This Die Holder Makes Thread Cutting Easy

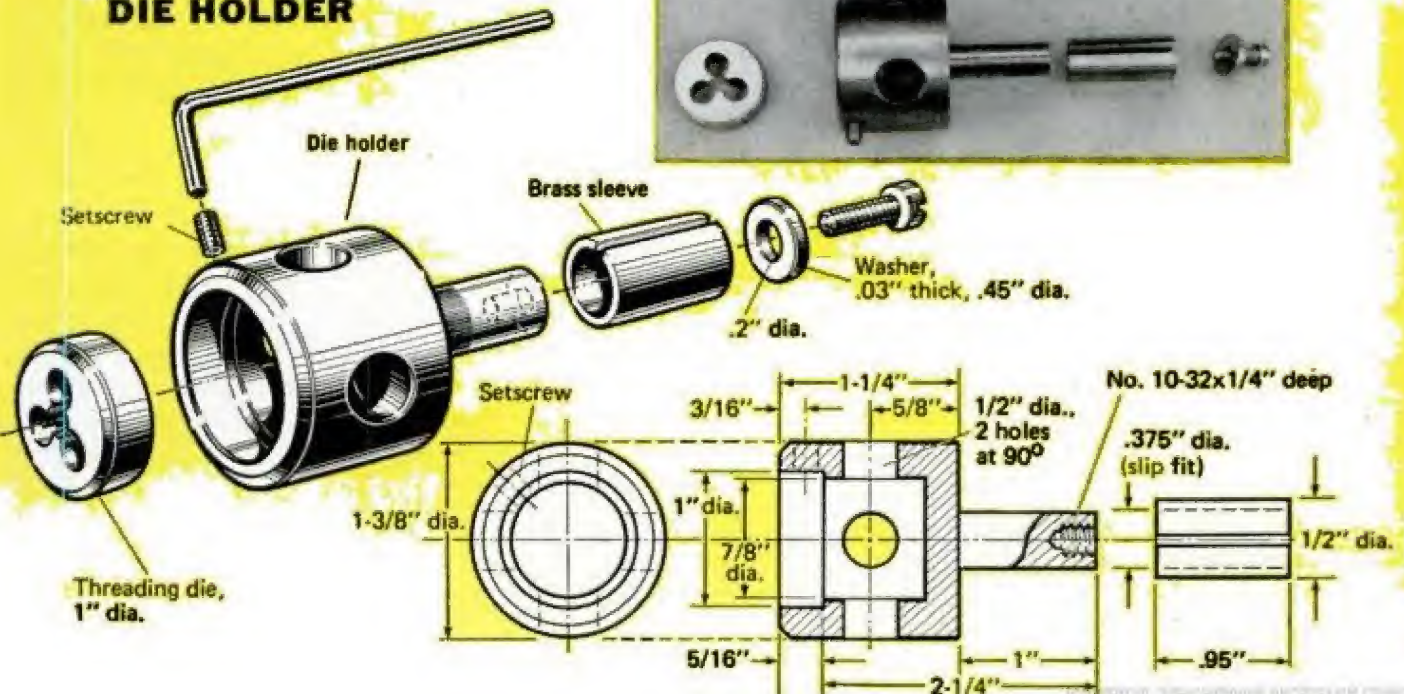
By ANTON M. BARKEY

WITH THIS TAILSTOCK die holder you will find it a lot easier to cut No. 12 or smaller-size threads in your lathe. It's easy to tighten the holder in a 1/2-in. drill chuck so that it will cut the threads you want. When the die hits a shoulder on the workpiece, the 3/8-in.-dia. shaft slips in the brass sleeve and stops the threading operation.

Alignment of the threading die and the workpiece is automatic with a three-jaw lathe chuck. The two cross holes give you full view of the back of the die and come in handy when you have to remove a jammed die.

The holder is turned primarily of mild steel and brass. Drill the 3/8-in. hole through the brass, then slit the sleeve with a hacksaw. Next, turn the die holder and drill the cross holes. The setscrew locks the die in place. Make certain that it's spaced between the cross holes as shown. ★★★

DIE HOLDER



Make Your Own Gemstone Faceting Machine



The art of lapidary—polishing stones to best display their qualities—is an ancient one. With this motor-driven machine, you can do it effortlessly

By MOODIE E. BRAUN JR.

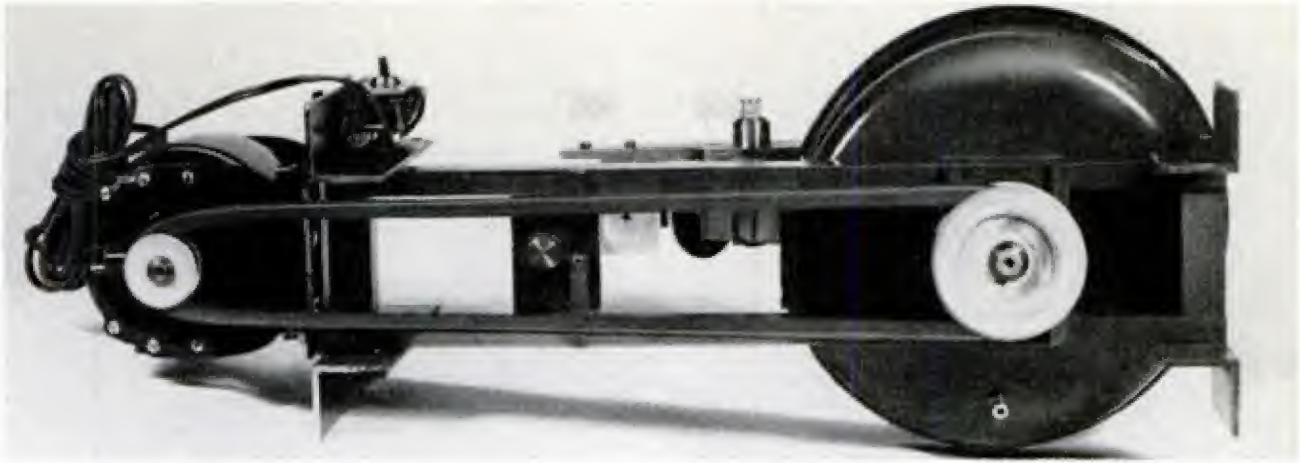


LAP PLATE can be of copper, tin or plastic, depending on faceting step. Pie tin acts as splash guard

UNLESS YOU HAVE SEEN someone cutting and polishing a stone, or tried it yourself, you'll be amazed at the satisfaction you get from bringing out the inherent beauty of a stone. The art of lapidary has fascinated man for centuries, and many methods have been devised for doing it.

Nowadays, all you need is a faceting machine like the shop-built version described here, plus a set of cutting and polishing laps, polishing powders, a selection of dops (tools) for holding stones, a dop transfer kit and the patience to follow step-by-step instructions. (These can be found in any good gem-faceting book. One that I recommend is *Gemcraft* by LeLande Quick and Hugh Leiper, F.C.A., published by Chilton Co., Philadelphia, Pa.)

Though a detailed explanation of lapidary methods is beyond the scope of this



BOTTOM VIEW of faceting machine shows relationship of work end of rig to the motor. Lap plate itself is commercially available item and usually has a 1/2-in. mounting hole which is placed over the shaft

article, a description of some basic steps is necessary in order to understand the functions of the various machine components. For example, with a round, brilliant cut stone the first stage is preparation of the preform. This is simply the process of grinding the stone to a general shape to permit easier and more accurate finishing. With a round brilliant, the first preform shaping is to grind and polish the top or table by hand, using the lap plate and holding the stone with your fingers. The next step is to grind the outer circumference of the top, to the largest circular diameter possible. The final step is to shape the stone so that it resembles a turnip.

The stone is then mounted on a cone-shaped dop using a transfer jig. The transfer jig is a simple, inexpensive accessory which enables a stone to be placed accurately on a dop or to be transferred from one dop to another. (Use and selection of dops is described in the book mentioned on the preceding page). The dop is then mounted in the machine's index head and the facets are ground and polished according to the shape and type of stone.

During all cutting steps a small but steady drip of water is required on the lap plate to cool the stone and to wash away the cuttings.

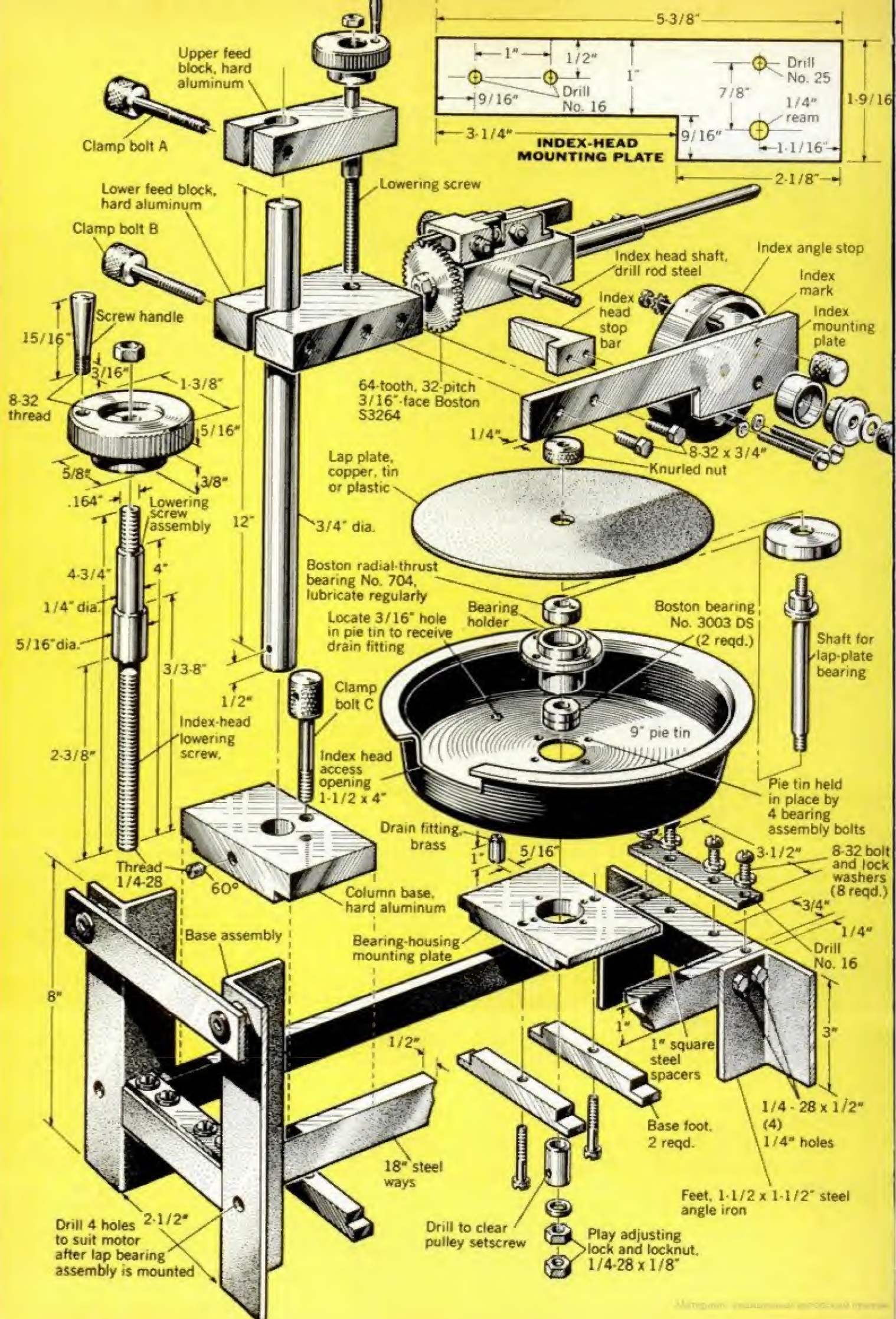
A faceting machine must be capable of holding a stone at any given preset angle from 0° to 90° in a plane perpendicular to the revolving lap plate. At the same time, the machine must allow rotation of the stone relative to the lap plate surface in up to 64 accurately spaced divisions. Finally, you need a pan surrounding

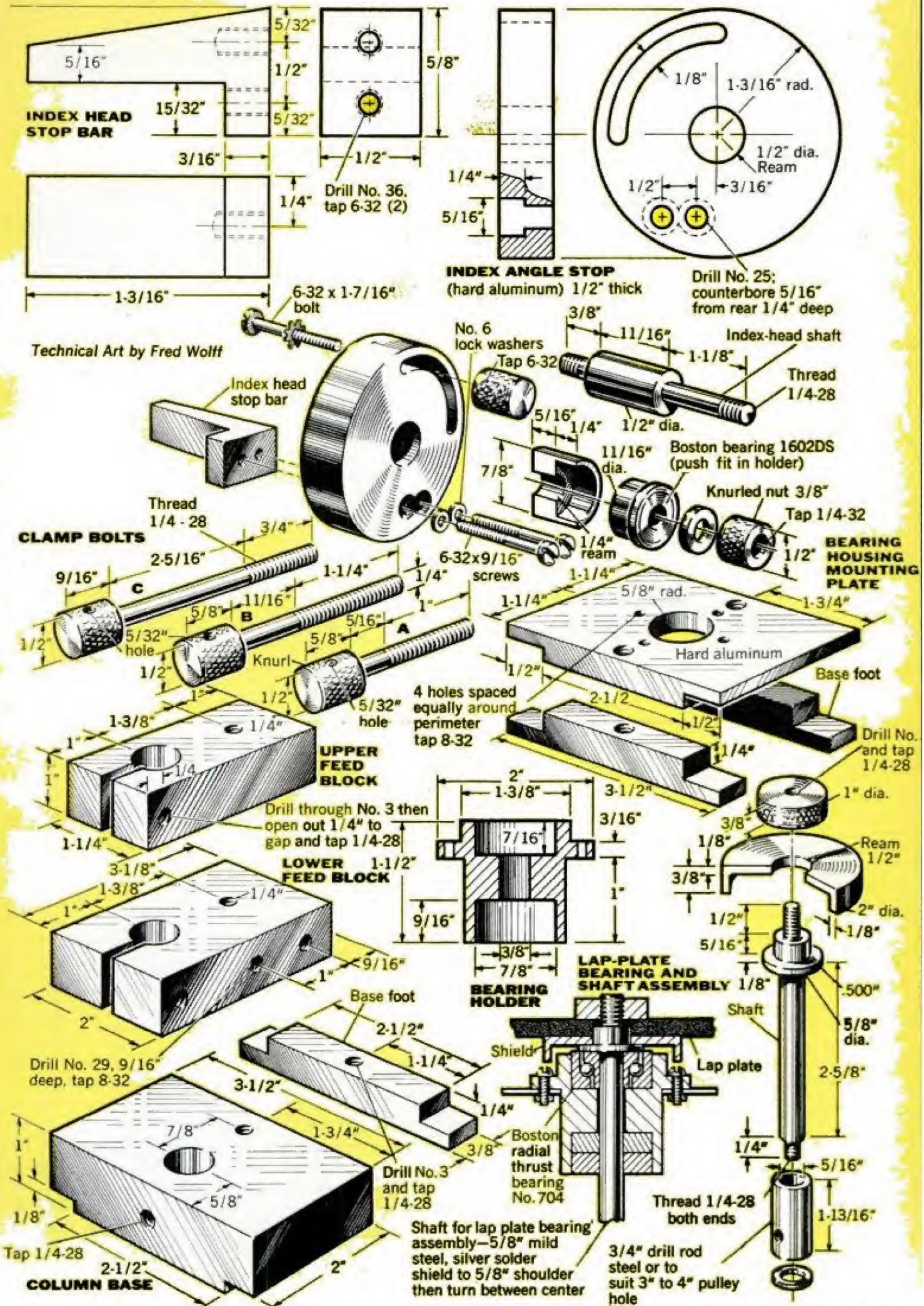
the lap plate to collect and drain away the cooling water and cuttings.

Begin construction with the machine bed. Make the bed ways as shown and separate them with two 1-in.-square steel spacers. Assemble the frame first by clamping the spacer to the ways. These strips will align the frame and hold it accurately for drilling the two large 1/4-28 bolt holes in each corner. Make the four bed feet from angle iron and finish the bottom ends accurately by milling, turning or careful filing. The bolt holes in the feet should be carefully laid out and then spot-faced after drilling. When the bed is completely fabricated, check the parallel alignment of the ways carefully before proceeding, and eliminate any rocking tendency the bed may have. The motor mounting holes should be drilled after the lap-plate bearing assembly is completed and mounted to insure accurate belt alignment.

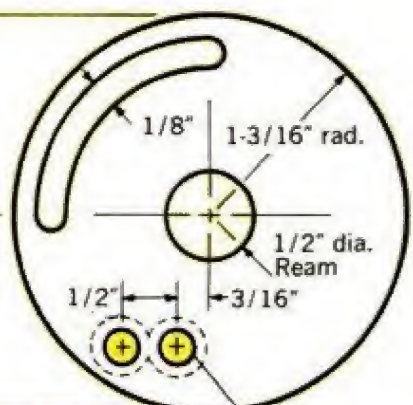
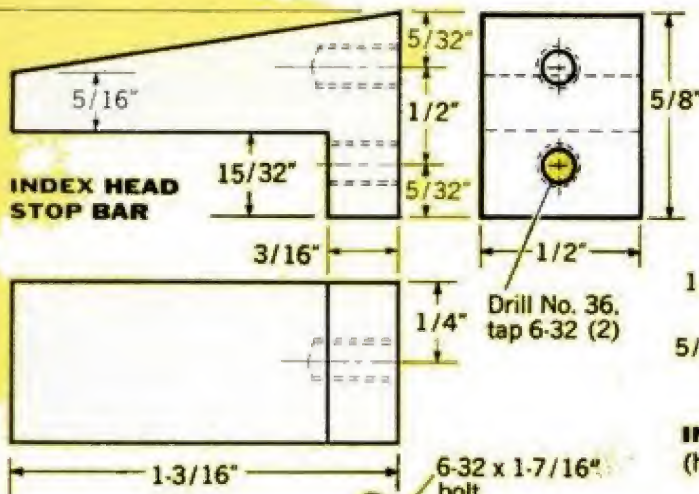
Next, machine the lap-plate, bearing-housing assembly. The bearing housing itself can be made from hard aluminum or brass, and its machining is straightforward turning and boring. The top bearing is a radial thrust-type (Boston No. 704) necessary to support the weight of the lap plate while the two lower bearings (Boston No. 3003DS) absorb the belt tension load. All bearings should be a tight push-fit in the housing. A nut and lock-nut on the bottom of the lap-plate shaft can be adjusted to eliminate any bearing play.

The bearing housing is mounted to the frame with the large center mounting hole in the plate, bored 1 1/4 in. using a lathe faceplate or four-jaw chuck. The





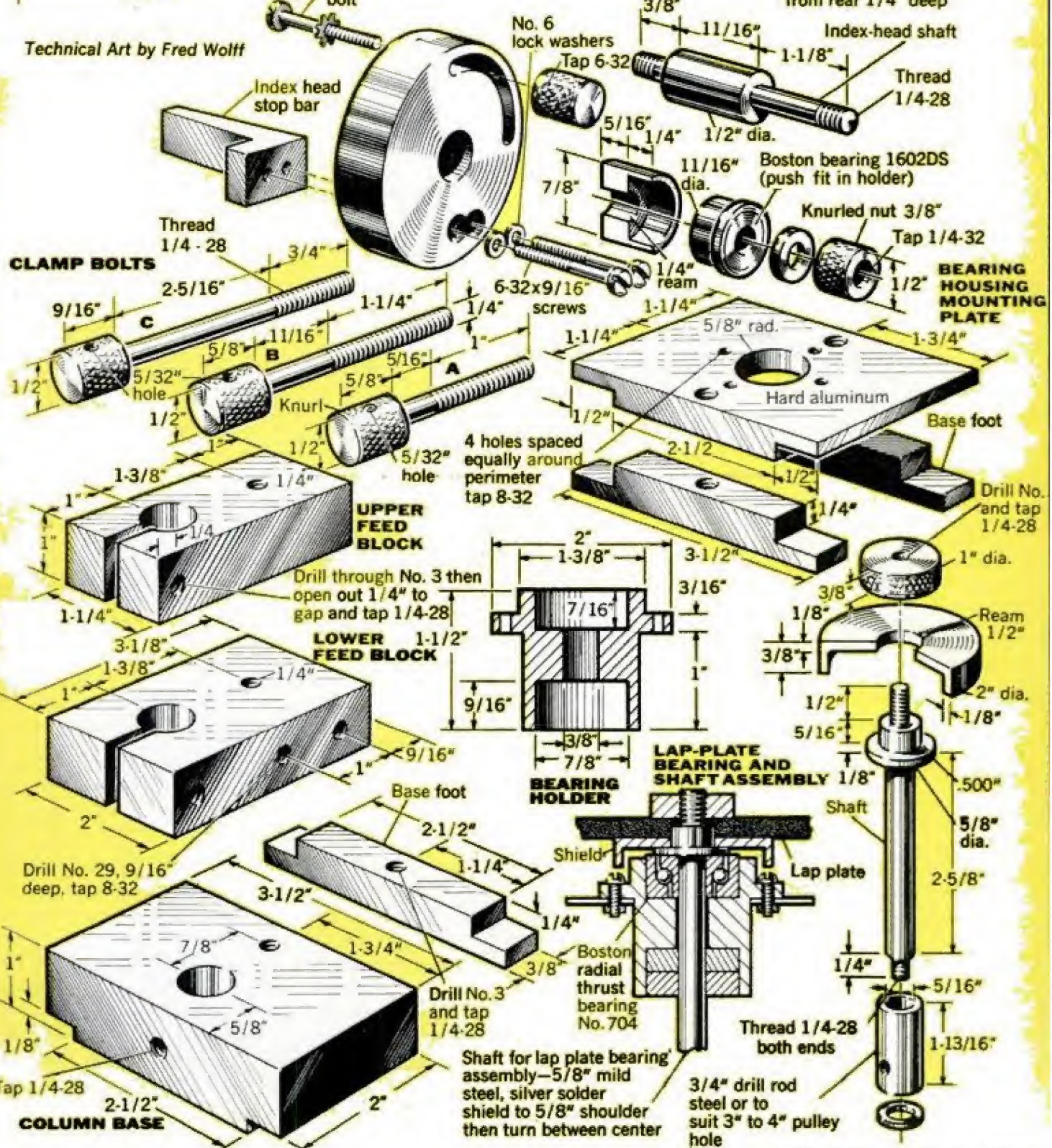
INDEX HEAD STOP BAR

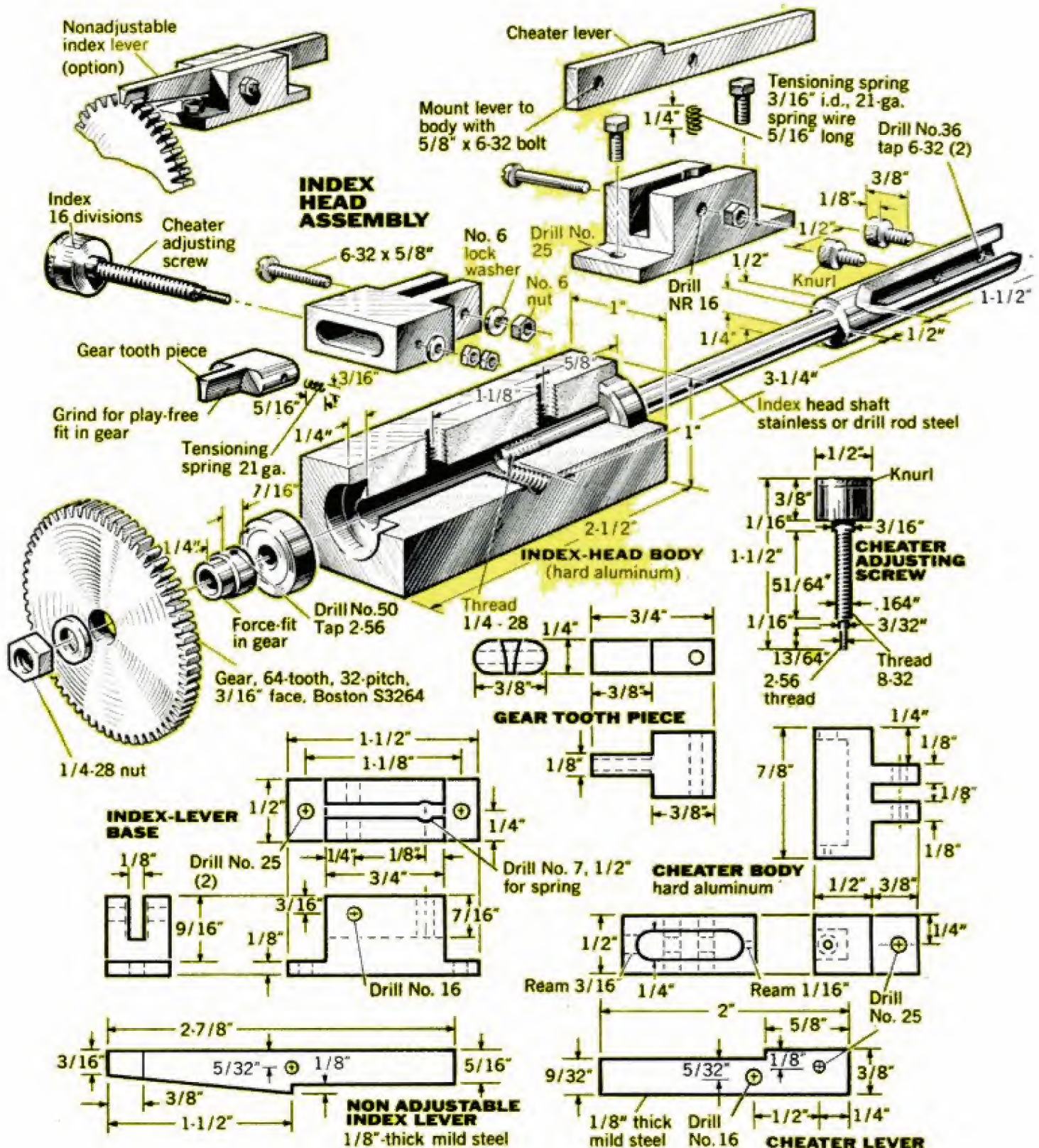


INDEX ANGLE STOP
(hard aluminum) 1/2" thick

Drill No. 25; counterbore 5/16" from rear 1/4" deep

Technical Art by Fred Wolff

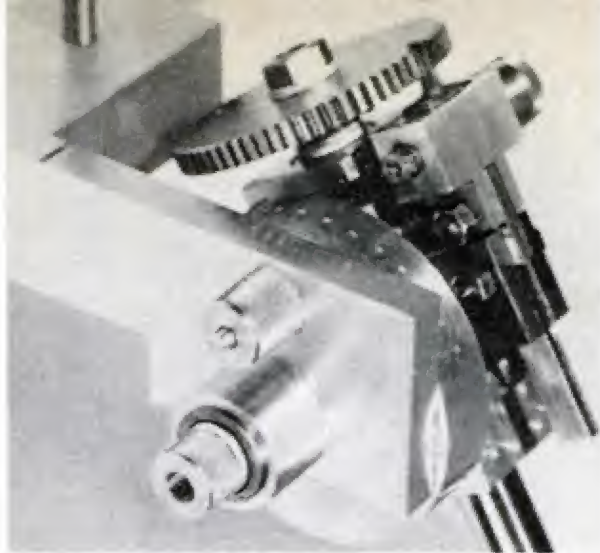




four housing bolt holes are drilled using the holes previously drilled in the bearing-housing flange as a guide.

Make the lap-plate splash pan and cut out an opening to allow unrestricted access by the index head when cutting stone girdles at 0° angles. Solder a 3/16-in. o.d. brass drain-tube pipe to the pan in a position to clear the bed. The lap-plate shaft is silver-soldered to a brass bearing shield

after both are individually machined. With the shield soldered to the shaft, true it up by final turning with the assembly held between centers or in a collet to insure true running of the lap plate after assembly. Determine belt length after the motor is selected and mounted to allow a distance of 10 1/4 in. from the edge of the lap plate to the motor end of the frame. Use a 3 to 4-in. pulley on the lap-plate



FACETING MACHINE must be capable of holding a stone at any angle from 0° to 90° from perpendicular. Text tells which bearings to use and where to get them. Cheater (right) is advised as addition

bearing and 1½-in. pulley on the motor. With the frame assembled, the motor mounted and the lap plate running satisfactorily, construction can proceed on the vertical column and height adjusting mechanism.

The vertical column is made with the ends faced in the lathe to an overall length of 12 in. and a hole drilled ½ in. from one end with a ¼-in. center drill to receive a locking setscrew in the column base. The column base has deep insets milled in each side leaving the center 2½ in. wide (to fit smoothly between the bed ways). The base is clamped to the bed from one edge by a knurled clamp screw.

The two fine-feed mechanism blocks which operate on the vertical column to raise and lower the index head are also machined from 1-in. hard aluminum. A ¾-in. hole for fitting on the column should be bored or reamed ¾ in., then an expansion cut made with a slitting saw in the lathe or milling machine, or cut carefully with a thin hacksaw. The ¼-in. hole in the upper block serves as a bearing for the lowering screw and should be reamed. The rest of the work on the feed blocks is straightforward requiring no special instructions. The fine-feed adjusting screw is made from ⅝-in. drill rod and must be machined to close diameter tolerance in order to minimize any play. *Both clamping screws are always locked while actually cutting the stone.*

The only critical work on the index-head mounting plate is the distance between the ¼-in. hole, the No. 25 hole immediately above it and the index mark



on the top edge. The center of the two holes *must* be exactly in line with the index mark and at a right angle to the horizontal axis of the mounting plate.

The index-head assembly is the heart of the faceting machine and considerable care should be taken in constructing it. Excessive play in any direction will show up as inaccuracies in the finished stone. Machine the index-head body and face each end to an overall length of 2½ in., then accurately lay out the center on one end. Make a deep "pop" with a center punch, and adjust to run truly in a four-jaw chuck. Start with a center hole, then drill all the way through ⅝ in.

A recess is then bored out 1⅛ in. in dia. by ¼ in. deep to hold (with a tight push-fit) one of the index-head shaft bearings (Boston No. 160DS). Remove the body and chuck a scrap piece of ½-in., or larger, steel rod with about 2 in. protruding. Turn this rod to a diameter which fits tightly in the ⅝-in. hole in the index-head body. Twist the end of the body with the bored recess onto the rod and machine the second bearing recess. Mark out the pivot shaft hole on one side of the body and drill with a No. 3 drill right through to the ⅝-in. center hole. Before tapping, drill into the No. 3 hole with a 1⅜-in. drill to a depth of ⅜ in., then tap 14-28. This will enable the pivot shaft to be locked when tightened up to the ¼-in. shoulder of the threaded end. To finish, lay out, drill, and tap the index lever base mounting holes.

The index-head pivot shaft should be

(Please turn to page 170)

Add a Limit Switch To Your Lathe Carriage

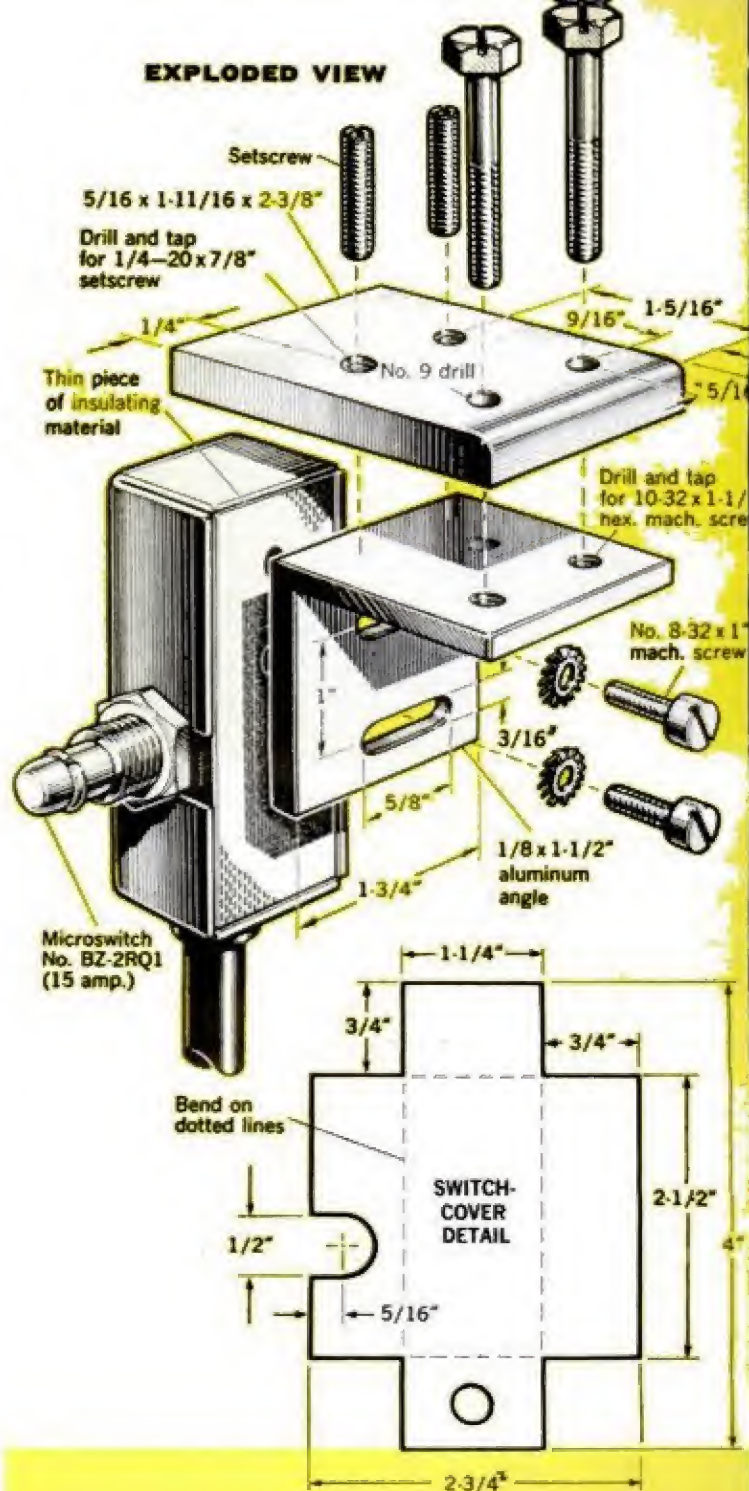
IN TURNING OPERATIONS where it is necessary to run the cutting tool as close to the headstock as possible, there's usually a risk of running the compound rest into the chuck or dog. While a micrometer stop is satisfactory when hand-feeding, extra caution should be exercised when you use power feed, because if the feed isn't disengaged before the stop is reached, damage to lead screw and gears could occur. With this attachment, the carriage can be fed without attention since the lathe automatically shuts off when the compound rest hits a switch of the attachment.

To minimize the chance of damage to the ways, make the clamp of aluminum. The pair of $\frac{1}{4}$ -in. setscrews is simply intended to insure parallelism between the two clamping members. Two hex-head machine screws are used to secure the clamp to the ways.

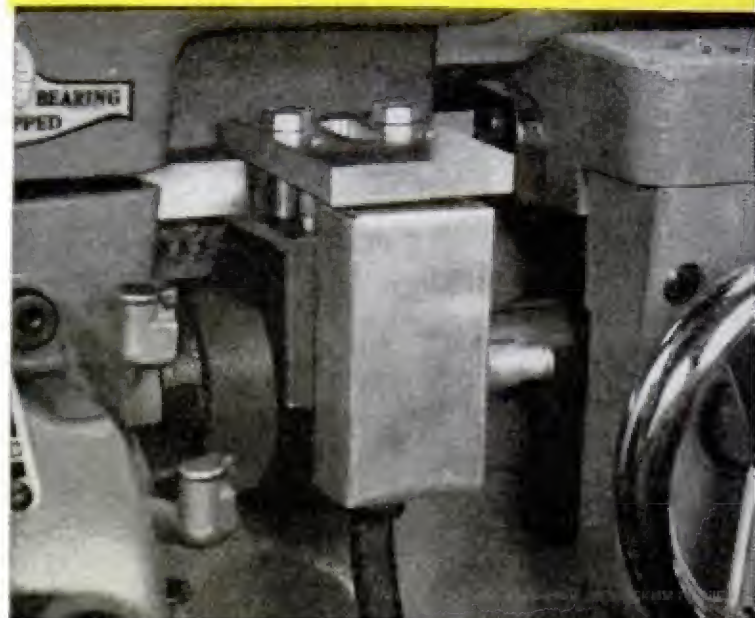
Though you can use several types of microswitches, I found that the one indicated on the drawing performs adequately. It has a rating of 15 amps., plus the capability of handling the current needed for my Atlas lathe motor. It also permits enough free travel to take up any carriage overrun. (There is always a slight carriage overrun after power is cut, especially when using a chuck, light cut or combination of both.) The switch shown permits a carriage overrun of approximately .25 in.

To attach the switch to the angle, drill and tap two holes and fasten with machine screws. To prevent shorted connections, separate switch and angle with insulating material. The aluminum case should also be lined with the same material.

—Arthur Volz



ELONGATED HOLE, obvious in photo but not used in art, is for adapting clamp to other uses as needed



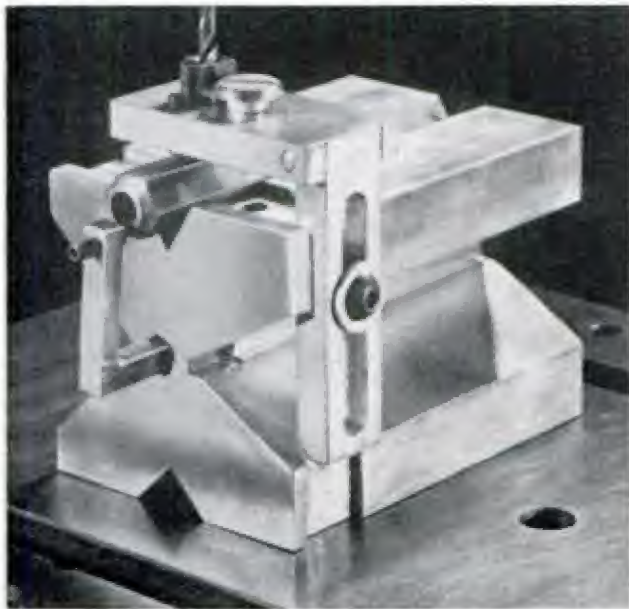
New tools you should know about



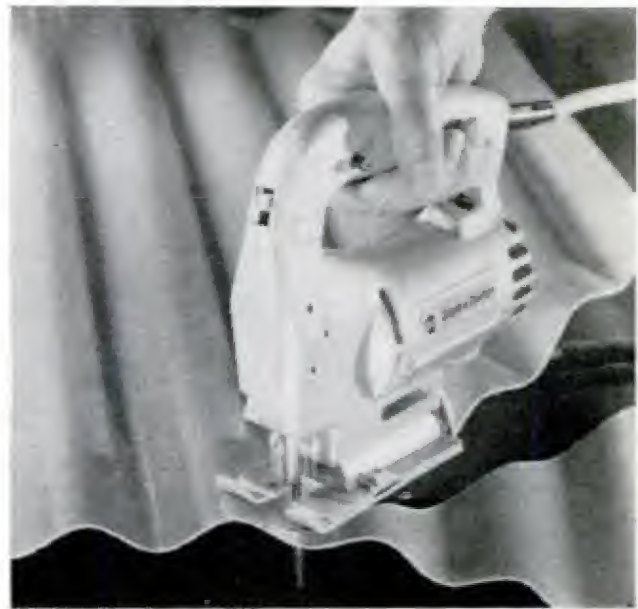
PORTABLE SAWHORSE labeled Trojan can be stored under a workbench or hung on the wall because when not in use it folds to a compact 6 in. sq. by 42 in. long. When opened, it automatically locks in a rigid position and gives a generous work surface with a 1000-lb. capacity. Sold at retail or by mail order, \$18 per pair. For information, write Trojan Folding Sawhorse, 2229 Jefferson Ave., S.E., Grand Rapids, Mich. 49507.



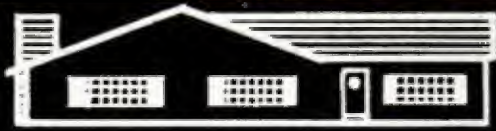
DRIVEN BY COMPRESSED AIR, the 1 $\frac{3}{4}$ -lb. Speed Ratchet Wrench is claimed to spin loosened fasteners on and off 90 percent faster than a conventional ratchet. Designed primarily for automobile work, the tool accommodates sockets up to 13/16 in. and uses a 3-in. extension for easy sparkplug changing. \$127.50. For nearest dealer, write Chicago Pneumatic Tool Co., 6 East 44th St., New York, N.Y. 10017.



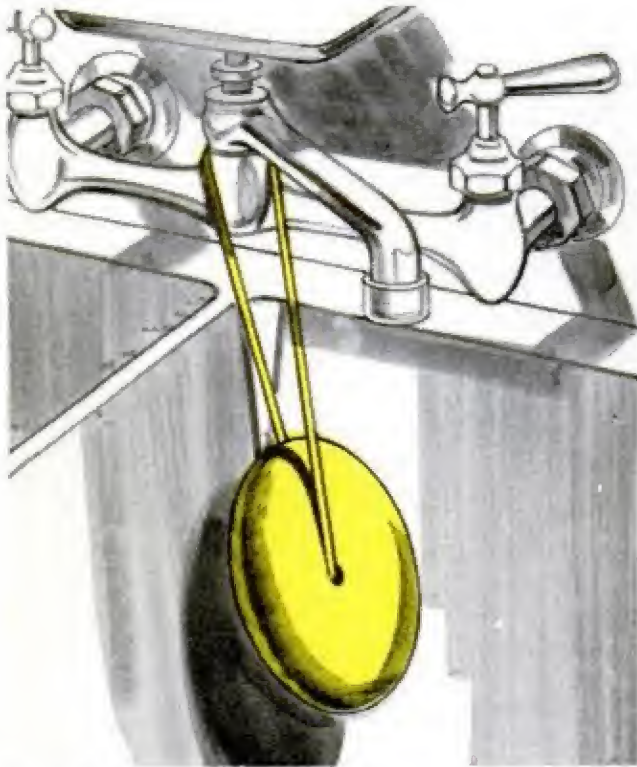
MULTIPURPOSE V-BLOCK measures 3x3x4 in., is designed to accommodate round, square or hexagonal workpieces from $\frac{1}{4}$ to 1 $\frac{1}{2}$ in. Each aluminum block has one bracket to drill from No. 80 to 5/16-in. holes using slip renewable bushings. The block also features a stop that enables you to control the distance of the hole from end of the part. \$18.50. NuDres Tool Co., 1534-F E. Chestnut Ave., Santa Ana, Calif. 92701.



THREE-SPEED JIGSAW boasts 3000 rpm for cutting wood and compositions, medium (2500 rpm) for soft sheet metal and pipe, and a low speed (2250) for hard metal, plastics and tile. Model 7545 has a calibrated tilting shoe for bevel cuts up to 45° and accepts a rip-fence, circle-cutting guide attachment. Available at hardware stores for \$35, the jigsaw is made by Black & Decker Manufacturing Co., Towson, Md. 21204.



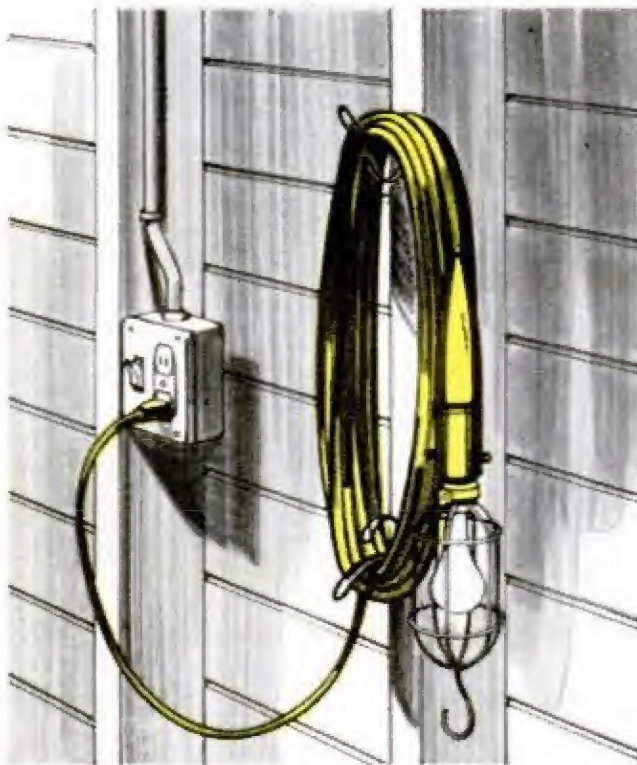
SOLVING



KEEP BAR SOAP from wandering by drilling a $\frac{1}{8}$ -in. hole through one end of the cake and inserting shoestring. With string looped over your laundry-tub faucet, soap is always at hand.—*Harry Wheeler*



A NEAT BIRD FEEDER can be quickly and inexpensively made from a plastic cottage-cheese container and three short lengths of wire. Fill it with wild bird seed and hang it from a branch.—*W. H. McClay*



TWO COATHANGER HOOKS fastened to a garage wall stud will do a neat job of storing a drop light. If light has a built-in switch, locate hangers so that the line can be kept plugged in.—*John F. Pilznienski*

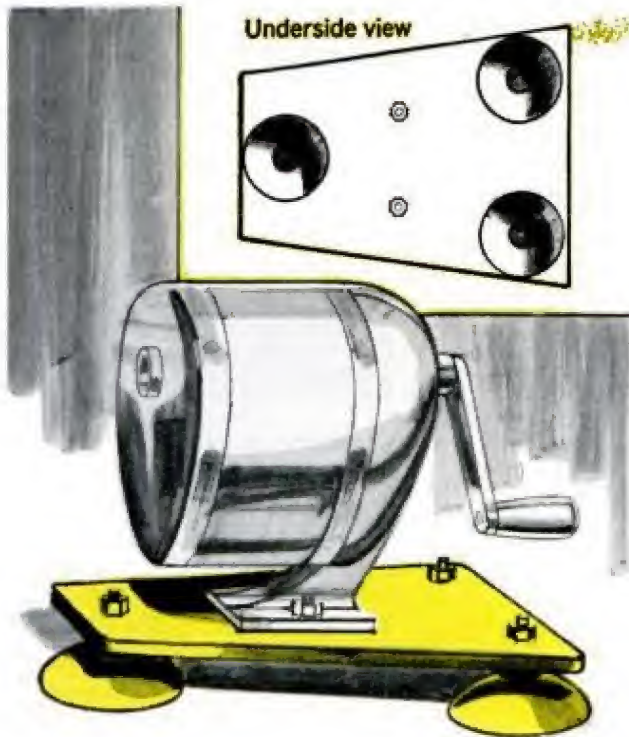


DRIED-OUT, FELT-TIP PENS can still serve a function if you use them to hold the seed packets to mark the plantings in your garden. Leave the marker in place until plants are identifiable.—*Charles Hardy*

POPULAR MECHANICS

HOME PROBLEMS

Illustrations by Adolph Brotman, Worman Associates



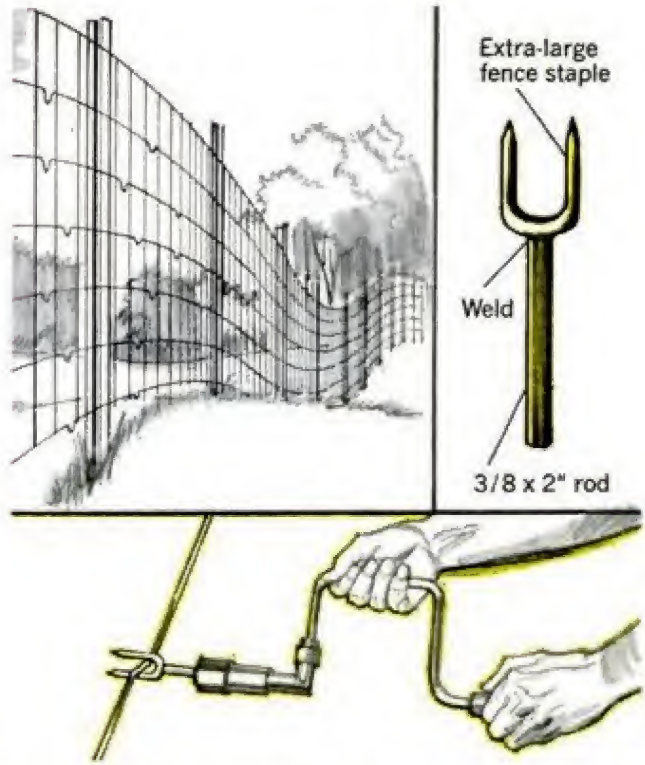
YOUR PENCIL SHARPENER can be carted to wherever you're working if you first mount it on a small piece of hardboard. Simply affix three or four small suction cups to the underside.—Harry Radzinsky



SAVE BB AND PELLET AMMO by rigging up a target that will trap any shot that hits the mark. To do it, fill a milk carton with cardboard or rags and hang it where shooting is safe.—George Mayerchak



EASEL FOR WEEKEND ARTISTS can be rigged by nailing a crossbar to an ordinary stepladder at any height desired. If removal is a must, fasten crossbar with screws instead of nails.—Gordon Ligocki



WAVY WIRE FENCES can be aligned with ground contour by welding a short rod to a heavy-duty staple. Easy way to use "tool" is to insert it in carpenter's brace and give it a quarter turn.—Albert T. Pippi

HINTS FROM READERS



Leaf-bag sleeve

You can make leaf raking and other yard cleanup easier with this method of keeping the disposal-bag mouth open for one-man stuffing. My wife and I use an old bottomless trashcan as a sleeve. For looks, I gave it a coat of paint and added cloverleaf designs.

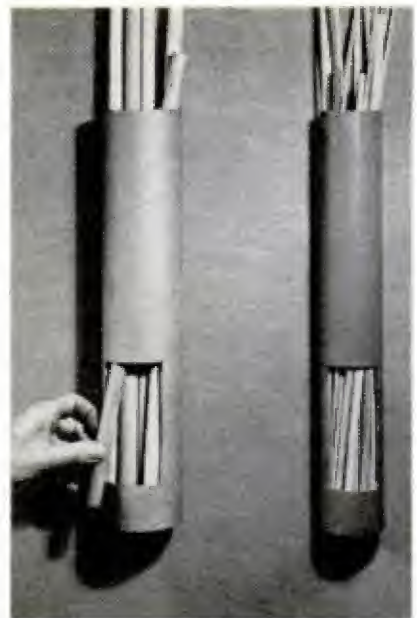
—W. Robert Proctor



Funnel pouring aid

Pouring liquids from one container through a funnel and into a small-neck bottle can be wearying. Should your eye wander, the liquid might overflow. If you solder a piece of wire to the funnel spout, air can escape from the bottle and the pouring goes faster.

—W. H. McClay



Neater dowel storage

A cardboard tube provides compact storage for various-size dowels. Simply cut a wood plug to fit the inside diameter and tack in place to serve as the bottom. Cut an opening in the tube to accept your hand and fasten the holder to the wall with two hefty screws.

—Harry Wheeler

'Welding' plexiglass on a drill press

Next time you have to join cylindrical plastic to a flat piece, try this stunt for speed. Simply chuck the rod in your drill press and clamp the flat to the table. Lower the press until parts meet, then switch on medium-high speed. Friction causes the material to melt, but turn off drill the instant the flow starts.

—Jerry Gebby

NEXT MONTH IN SHOP AND CRAFTS

EARLY AMERICAN GOSSIP BENCH. A handy place to sit and gab, this handsome spindle-back bench makes for comfortable conversation. Reproduced from an authentic Early American piece in our own cabinet shop, it captures the warmth and charm that colonial pieces offer and is something you'll want to add to your Early American collection. Watch for it in the March PM.

MAKE A GRAND ENTRY. If your foyer looks a little drab, you can perk up its appearance by remodeling the existing door and updating the entryway with a paneled room divider. You'll find one homeowner's attractive solution in the March PM.

HANDSOME PROJECTS OF PLEXIGLASS. They look as if they're molded of glass, and you won't believe you can make them yourself—but you can from sheets of lustrous acrylic plastic. This striking group of home furniture and accessories includes a telephone stand, magazine rack, cookbook holder, wine bottle rack, terrarium and chairside table. They are projects you'll be eager to make as soon as you pick up the March issue.

PLUS: A mini drill press for hobbyists, how to add an indexing attachment to your lathe, easy way to bend tiny tubing, and much, much more.

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WHAT ABOUT AIR BAGS?

(Continued from page 65)

key questions before they install air cushions in cars.

1. What happens to passengers who are not in an upright, head-on position when the pillow inflates? In simulated crashes with dummies, a mannequin's legs were crushed as it "braced" itself in anticipation of a collision. What happens if a child is kneeling on the seat or standing on the floor? What happens if driver or passenger are leaning forward so they receive the full impact of the exploding bag on the head? In an airtight car, the force of the bag going off can blow out the windows and doors. What happens to passengers who aren't wearing seat belts when the doors fly off?

2. What about damage to the ears of car occupants from the sound and pressure of a bag inflating? Tests carried out by the car companies indicate about 75 percent of motorists can take the full force of

What happens to passengers who aren't wearing seat belts when the doors fly off?

the sound pressure waves with no ill effect. If the sound grazes the ear—that is if the passenger is facing the source of the noise—about 95 percent of the population can tolerate the sound without any lasting injury to the ears. But what if the head is turned slightly so the full force of the explosion hits one ear? GM estimates that somewhere between 5 and 25 percent of the population would suffer severe hearing damage from the explosive noise of the bag going off.

3. What happens if a bag blows in a noncrash situation? The auto manufacturers say the present hardware used in air bags just isn't good enough to prevent this from happening.

4. How reliable will the air pillows be after being stored in the dash for four or five years? Will they still function?

5. Air bags provide protection only in head-on collisions or at angles of about 30° left and right of straight-on. This covers about 50 percent of all accidents. But what about the other 50 percent—side-on collisions, rear impacts, sideswipes and rollovers? Would air cushions help or hinder drivers involved in nonfrontal collisions?

6. Chrysler raises the question of what happens to passengers smoking pipes or cigars, people wearing glasses and false

teeth, the driver whose arm is upraised in front of his face when the bag blasts off. Does he get the stem of his pipe shoved down his gullet? Are his glasses smashed against his eyes?

Eaton, Yale & Towne, the pioneer producer of air pillows, argues that the auto companies are overcautious and overconcerned on several points.

"We were also concerned about the noise factor," an Eaton executive explains. "We conducted a comprehensive series of tests on this at Wright Field. Dr. Charles Nixon, the impulse noise expert at Wright, ran 84 tests involving 91 human volunteers and found they suffered no damage to their hearing."

Using a car with a small passenger compartment, Eaton's tests showed its system has about the same peak sound pressure as a shotgun. All participants in the tests were healthy adults. (There is little concern about damage to the eardrums of children because their drums are smaller and more flexible than adults'.) But questions still remain about the ears of older people and motorists with ear trouble.

Eaton also doubts there's much danger of an accidental triggering of the mechanism. "In more than two million miles of testing the sensor over all kinds of roads and obstacles, we haven't experienced a single accidental triggering," a company engineer declares. "But even if the unit was accidentally detonated, there would be no safety calamity because it operates at such terrific speed that it doesn't have much opportunity to incapacitate the driver."

Finally, Eaton is confident its system would function properly after being stored for five years. After five years or so, major components might have to be replaced. They'd also have to be replaced after a collision. Replacement costs, the company estimates, would be in the area of \$40 to \$50 per pillow.

The auto manufacturers have a lot of respect for Eaton. But "We don't question their findings," declares a safety engineer for a Big Three company. "But all the research in the world isn't going to get us off the hook if we become embroiled in lawsuits because the air bags we install on cars fail or malfunction."

Despite all the dangling question marks, the Federal government has ordered auto firms to install air bags or some type of passive restraint in front seats starting July 1, 1973 and in rear seats a year later—July 1, 1974.

Ford and GM say they will put a few hundred air bags on cars this year on a

(Please turn to page 170)

It's the same truck. Same load-lovin' overhead cam engine. Same torsion bar front and heavy-duty rear suspension. Same steel girder frame. And a split personality.

The Datsun busy body picks up on all the tough assignments.

A six foot all-steel bed and flat-loading tailgate take on surfboards, bikes, hay bales and branding irons. Tie down hooks all 'round see that they stay on.

Your Datsun dealer will show you a variety of campers that snuggle right in there, too. Switching loads is simple. You can take this

busy body on vacation over the weekend and put it back to work bright and early Monday morning.

Slip into the comfortable, hi-visibility cab. Latch onto the smooth shifting 4-speed stick.

Up to 25 miles per gallon economy and load-proven reliability.

About the best thing you can do with the Datsun Pickup is haul off and buy one. A lot of haulers have. It's the number-one selling import truck. And there's no two ways about that.

At just \$1916*, no wonder.

Busy body



DATSUN 
Drive a Datsun... then decide.

*Plus tax, license, local freight, dealer preparation. Specifications and price subject to change without notice.

WHAT ABOUT AIR BAGS?

(Continued from page 168)

trial basis. (The cars will not be sold to the general public.) Ford says it will step up installations to 2000 to 4000 cars in 1972 and offer the item as an option in 20,000 to 40,000 vehicles in 1973. GM has volunteered to install 25,000 units in 1972, make the equipment optional on some '73 cars and standard equipment on '75 models. American Motors says it's game to offer air bags as an option on one car line in '73 and put the device on all '76 models. Chrysler also favors a program of progressive installation, beginning with a few hundred units and culminating with 100 percent installation rate by Jan. 1, 1975.

The National Highway Safety Bureau still has some questions of its own on air bags. The Bureau recently awarded a \$500,000 contract to Cornell Aeronautical Laboratory to evaluate designs and to develop new passive protection systems.

The auto firms are resigned to the fact they are going to have to install some type of passive restraint on cars sooner or later. They just aren't convinced air bags are the only or best answer. But there's no conspiracy to scuttle air bags.

"Give us time to improve it," the auto-makers are saying, "or give us time to come up with something else that'll do the job without the risks."

Something else? There are a lot of ideas kicking around—blankets; nets and movable curtains that drop down in front of the body; Toyota's radar sensor to deploy the bag at the instant before a crash; pop-out instrument panels that shoot forward to cushion the head and chest (technically the panel is called an articulated dash); seats that curve around the shoulders combined with a chest protector that encases the body; and, from Ford, a device that prevents you from starting the car unless you're wearing the seat belt and/or shoulder harness.

You'll see air bags or one or more of these gadgets as standard equipment on all new cars before 1974. ★★★

GEMSTONE FACETING MACHINE

(Continued from page 161)

machined with accuracy with both ends reduced to $\frac{1}{4}$ in. diameter for $\frac{3}{8}$ in. and $1\frac{1}{8}$ -in. lengths. Tighten the shorter end into the index head body. The index-head dop shaft also requires careful machining to insure a play-free fit in the bearings. This shaft should be machined with one end turned to $\frac{1}{4}$ -in. dia. for a length of $3\frac{1}{4}$ in. and thread the tip $\frac{1}{4}$ -28 for $\frac{5}{16}$ in.

Then drill a $1\frac{1}{64}$ -in. hole $1\frac{1}{4}$ in. deep in the $\frac{1}{2}$ -in. dia. end and follow by reaming $\frac{1}{4}$ in. Use a tail-stock "V" drill pad and drill two No. 36 holes in the $\frac{1}{2}$ -in. dia. part of the shaft $\frac{1}{8}$ and $\frac{5}{8}$ in. respectively from the end. Drill right through into the $\frac{1}{4}$ -in. reamed hole and tap 6-32. Two $\frac{3}{8}$ -in. 6-32 knurled screws with 45° tips are machined to engage the groove found in dop shafts.

The index gear I selected is a Boston No. S3264, 64-tooth, 32-pitch, $\frac{3}{16}$ -in.-face steel gear with a $\frac{3}{8}$ -in. hole. Since the majority of stones are cut in multiples of 8 facets, this 64-tooth gear will permit indexing a wide selection of facets.

The index lever and base is machined using a lathe milling attachment or milling machine. Any vertical play of the lever is not important but there should be *no side play*. Also, the gear end of the lever should be carefully ground for a play-free fit in the gear teeth. A simple, non-adjustable index lever could be used but experience proves that an adjustable lever (called a cheater) is useful. As with most mechanical devices, things are never absolutely perfect and a cheater enables minute adjustments to be made. Its construction is fairly simple. The spring-loaded gear-tooth piece eliminates play, and, as with the simple lever, careful grinding is required for a close fit with the gear teeth to eliminate play and to bring the lever level when it's engaged.

In order to eliminate lateral play of the index head, compensate for pivot shaft wear and to adjust index head lowering tension, the index head which pivots in the index-head mounting plate is also supported by a friction adjusting mechanism. This device consists of a brass bearing holder which serves as an additional $\frac{1}{4}$ -in. bearing surface for the index head-pivot shaft and holder for a friction adjusting ball bearing. The purpose of the ball bearing is to provide a friction-free surface which will allow the adjusting nut to be tightened to any setting without being loosened by shaft rotation.

The final major component to make is the angle stop. The rough shape is cut by hacksaw, and after you mark the center and scribe to interesting lines 90° apart, a $\frac{1}{2}$ -in. hole is reamed in the center of the rough piece. The stop is then mounted on a mandrel and turned to a $2\frac{3}{8}$ -in. dia.

To finish, mount a switch on one of the legs, connect the motor in series with the switch and a power cord, arrange for a water supply, and cut a 2-in. length of $\frac{5}{32}$ -in. drill-rod steel for a clamping screw tightening lever. Finally, paint all non-working steel surfaces on the bed with two coats of rust-resistant enamel. ★★★



I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

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CASSETTE OR CARTRIDGE?

(Continued from page 75)

two more at the back. The added rear speakers create a rich, reverberant, room-filling sound simulating the realism and spaciousness of concert-hall listening. RCA now offers such a system, complete with four speakers, for under \$200. Motorola has another, for car installation.

Eight-track cartridges are ideally suited to four-channel sound since they can provide four tracks in each direction. The tracks can also be arranged so they're compatible with regular two-channel stereo cartridges. While cassettes can be adapted to quadrasonic sound, they don't lend themselves as readily to this new format. Norelco and Ampex are experimenting with a four-channel cassette system, but have nothing on the market yet. If quad tapes become popular in the eight-track configuration, they could keep cartridges alive for a good long time.

Meanwhile, cassettes are getting a big

Soon . . . you'll play all selections on a cassette without removing or turning it . . .

lift from another spectacular development: the so-called Dolby system for suppressing background tape noise. Mini tapes have long been plagued by a high level of hiss because of their narrow track width and slow speed. To avoid overloading the tape, it's necessary to record the original signal at low volume, then boost it in playback to proper loudness for listening. The trouble is, noise created in the recording gets boosted in playback with the music.

In the Dolby system, low-volume, high-frequency signals—where the hiss problem is greatest—are boosted *before* they're recorded. Because they're naturally low in volume anyway, they can be amplified without overloading the tape. In playback, these high-frequency signals are then cut back to proper listening volume, reducing hiss as well. The result is a cleaner, quieter tape.

At the moment, Harman-Kardon, Fisher and Advent lead the way with Dolby-equipped cassette decks. They're premium-priced—about \$200 to \$260—but offer top-quality hi-fi. High-performance cassette decks without Dolby circuitry are sold by Panasonic, Craig, Concord, Sony, Ampex, Aiwa, 3M/Wollensak, RCA, TEAC, Toshiba, Allied and Lafayette for about \$90 to \$130.

The problem of reversing a cassette is

also getting attention. The sticker is that a cassette has only three slots in its plastic housing—one for the pinch roller that presses the tape against the driving capstan, one for the record/playback head, and one for the erase head. To reverse a cassette, you need a second pinch roller at the other end to drive the tape in the opposite direction. This takes up the hole normally used for the erase head, leaving only one center opening for record, playback and erase functions. For a four-track stereo cassette, this calls for shoehorning eight heads—four for record/playback and four for erase—into an opening the size of a keyhole.

Head designers have actually accomplished this prodigious feat and reversible cassette machines will be appearing soon. You'll be able to play everything on a cassette without having to turn it over.

Jumping the gun, Craig has already marketed an automatic-reversing cassette changer—Model 2805 for \$189. The catch is it's a playback-only machine and thus needs no erase head or combined record/playback head. The second pinch roller is in the unused erase-head slot, and a simple four-track playback head goes in the center gap.

Norelco has gotten around the reversing problem with its clever flip-over arrangement that actually turns the cassettes instead of playing them in both directions. The device is in the form of a separate plastic chute attachment that will fit on several Norelco, Ampex and Bell & Howell cassette changers. It's \$19.95.

For the cartridge user, the Qatron rotary changer is a marvelous piece of machinery despite its somewhat hefty \$329.95 price tag. It can be mounted vertically or horizontally, and its rotary magazines are removable so you can store cartridges easily like trays of slides.

Stack-loading cassette changers are available from several makers. In addition to Craig's reversible machine, there are models by Panasonic, Norelco, Ampex, Bell & Howell and Denon (Nippon Columbia). The Panasonic, Ampex and Norelco units are about \$230, the Denon \$250. All are decks designed to play through an existing hi-fi system. Coming soon from Panasonic is a 20-cassette changer that will have automatic reversing similar to Craig's. Also in the works is a rotary changer by Benjamin that will hold cassettes in circular trays like Qatron's for cartridges. Most experts are convinced that the slick, handy tape changer will become the next big add-on hi-fi accessory, taking a place alongside the record changer as a major source of home entertainment. ★ ★ ★

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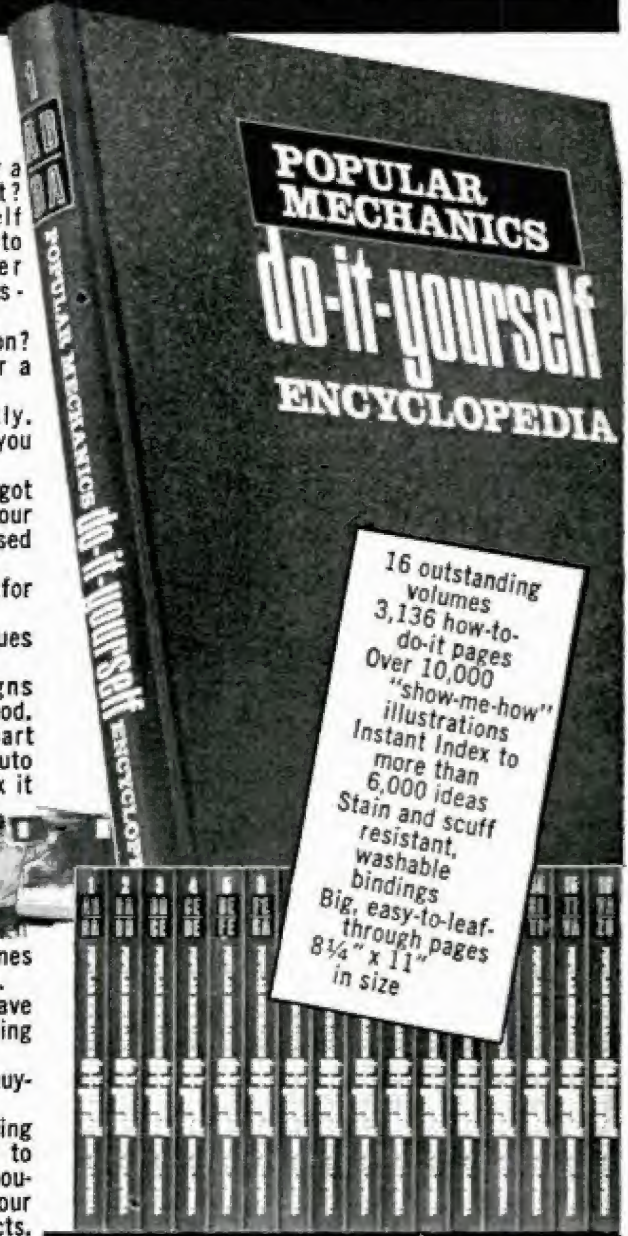
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THEY LIKE 'IMPOSSIBLE' JOBS

(Continued from page 79)

gering mechanisms, EG&G engineers perform many nuclear tasks. As contractors to the AEC, they're in on every atomic explosion. They drill the holes in which explosives are placed. They set up the devices that touch off the blast. They monitor the results.

They have a record of complete safety, though in the early days of testing, when devices were placed atop steel towers, Grier and Bernard O'Keefe, the smiling Irishman who is now president of EG&G, had a hair-raising experience. When the detonating apparatus was put into operation, nothing happened. No explosion. There was an atomic bomb sitting up there atop the tower, so somebody had to go up and disconnect the triggering apparatus.

"I'll go," Grier volunteered.

O'Keefe argued that he should do it.

... EG&G is checking out the nuclear engine that will propel spaceships to Mars.

They tossed a coin. Grier "won" and O'Keefe climbed the 300-foot tower.

"Well, I'm still here to tell about it," O'Keefe says with a twinkle in his eye. "Actually, I wasn't worried. Those were our instruments and I knew they were fail-safe." Since then, EG&G instrumented blasts have all gone off perfectly.

Within the desolate reaches of the Nevada test site is the barren ground known as Jackass Flats. Here EG&G is checking out the nuclear engine that may propel spaceships to Mars.

In the engineering world work being done on NERVA—Nuclear Engine for Rocket Vehicle Application—is considered as about the toughest of all testing jobs. There's no sweat up to the time the 23-foot-high engines are hauled to the test stand aboard a giant flatcar of the "Jackass & Western." And no sweat in particular about the elaborate instrumentation that tells EG&G engineers what's going on as the nuclear engine roars into life. Monitoring remote events which create an environment too hellish for humans is old stuff.

The problem comes when the engine, sizzling with radiation, is hauled back to a huge concrete test cell, a "den of robots" full of remote-control manipulative devices. There, mechanical arms take the engine apart—fuel elements, pipe connec-

tors, all the thousands of parts, right down to the tiniest bolts. And each part has to be studied by EG&G instruments which feed their findings into a computer system. How radioactive are the parts? How have they stood up during their fiery ordeal?

The complex system of TV cameras, sensors and readout instruments contrived by EG&G engineers will determine whether nuclear propulsion is going to get us on our way to Mars and beyond.

In the sprawling research center of Hydrospace, Inc., an EG&G subsidiary in Rockville, Md., engineers are carrying out a complicated monitoring job that may someday save your life. You can see a weird network of pipes, tubes, valves, dials, wires and transistors which, you may be surprised to learn, simulates the human circulatory system.

When the National Institutes of Health wanted a way to test the mechanical hearts it was developing, it turned to EG&G. The engineers figured they would build up a system of tubes into which you'd hook the "heart," letting it pump blood, or a bloodlike liquid, all the while monitoring its performance.

It wasn't easy. "You wouldn't believe how much sweat went into this one," says Lee Custer, the project manager.

In the first place, just how does the human circulatory system operate? Surprisingly, the engineers found wide gaps in that knowledge. For example, they had to know exact pressures at every point of the body—in the big toe, say. They had to know exactly what happened to these pressures under all the different circumstances that might affect the human heart. This required long searches of hospital records. Eventually, they had a pretty good idea how the human system works. But could they make their artificial one operate the same?

The problem of finding a plastic with exactly the elasticity of human arteries involved experiments with hundreds of possibilities.

The third problem was no cinch either. How do you get your man-made system to react just the way the human physiology does to a variety of conditions? First you find out what these reactions are; then you program them into a computer that tells your plastic system when to contract, tells the "heart" when and how much to speed up, when and how much to slow down.

After three years' hard work, the EG&G engineers triumphed. Medical experts say the mock circulatory system has brought closer the day when an artificial heart will be popped into place like a spare part into an automobile engine. ★★★

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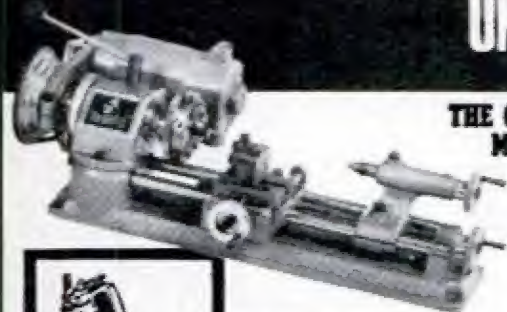
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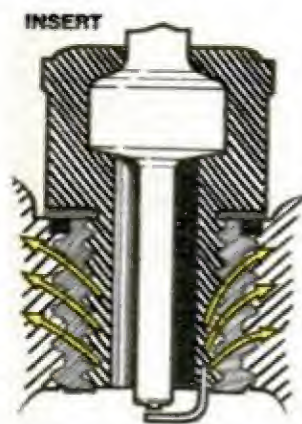
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The Racer's Threads

STRIPPED THREADS in sparkplug ports of aluminum-head engines have long been a headache—with the cure always something less than perfect. Kelox Industries of Dover, N.H., a subsidiary of Phillips Screw Co., however, feels that its precision-locking, threaded steel insert and installation tool offers the right answer. The "Newports," as they're called, were developed for aerospace applications, then tested in Formula Vee racers and adapted for automotive and small air-cooled engines like those in motorcycles, lawnmowers, snowmobiles and snow throwers.

...Do-It-Yourself Sparkplug-Port Repair Kit



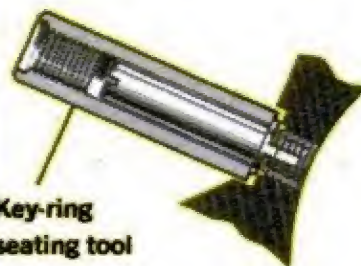
WIRE COIL repair, top, can leave small air spaces that block dissipation of heat of combustion (air being a poor conductor). One advantage of inserts is good heat dissipation for safe, efficient engine operation, cool plugs



TAP GUIDE is threaded onto the reamer-tap after the nose of the reamer-tap protrudes through the underside of the sparkplug port. Continue to thread the guide until it becomes snug against the cylinder head. The guide not only assists the reamer-tap in cutting the new threads but also helps to keep tool straight in the sparkplug port while cutting



INSERT INSTALLATION TOOL is used to thread the insert into the newly tapped port. The inserts were fitted in several Formula Vee cars and a Porsche racer so that they could be tested by Engine Technology, Inc. Such inserts, which are now available to fit all 14 and 18-mm plugs in any engine, have saved racing cylinder heads which cost as much as \$400



KEY-RING SEATING TOOL is designed to slide over the insert installation tool so that its lead end will be flush with the locking key ring. You then strike the end of the seating tool with a hammer in order to seat the ring flush with the insert, the two tangs broaching the newly cut threads in the port to keep the insert locked against rotation

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PM-50

Build This 'Glass-Top' WAGON-WHEEL TABLE

An old farm-wagon wheel and clear plastic provide the top for this rustic piece

By ELMA and WILLARD WALTNER

ALL KINDS OF ANTIQUES are being converted from their original purposes to new uses in home decorating. An old wagon wheel becomes a handsome coffee table when it's placed horizontally under a see-through top so that evidences of its age and hard use are displayed. You may have to do some scouting to find a wheel, but antique shops and swap shops usually have one or two lying about.

A 44-in. wheel was used for the table shown, so dimensions are sized accordingly. But there are no fancy or unusual construction techniques used to build the piece; thus, a different-size wheel won't rule out the project because dimensions can be altered.

Getting the wheel ready is not an instant process. Use a wire brush in a drill to remove the first layer of dirt, peeling paint and crumbling wood. When you get

to sound wood replace the brush with a coarse sanding disc and go over the spokes, felloes (wooden parts of the rim) and the wood parts of the hub.

Clean the hub of grease and use carving chisels, knife or pointed tool to finish cleaning out the cracks in the wood. Hand-sand to smooth the surface and bring out the grain of the wood, but don't worry about the cleaned-out cracks or repaired places; they add character to the wheel. To remove rust from the metal parts, use steel wool.

Give the wood parts two coats of varnish or lacquer but leave the iron parts "as is." If desired, metal can be given one coat of flat black paint rubbed lightly before it dries.

Since the base spoke placement may vary with different wheels, make a cardboard template for the legs and custom-

WIRE BRUSH chucked in drill is fast way to clean off heavy dirt. Follow with a coarse sandpaper

DIRT-FILLED crevices and cracks must be hand-cleaned with an awl, ice pick, fine-grit sandpaper

PAPER TEMPLATE is made for the legs. Variance may exist, so top cutout for each must fit spokes



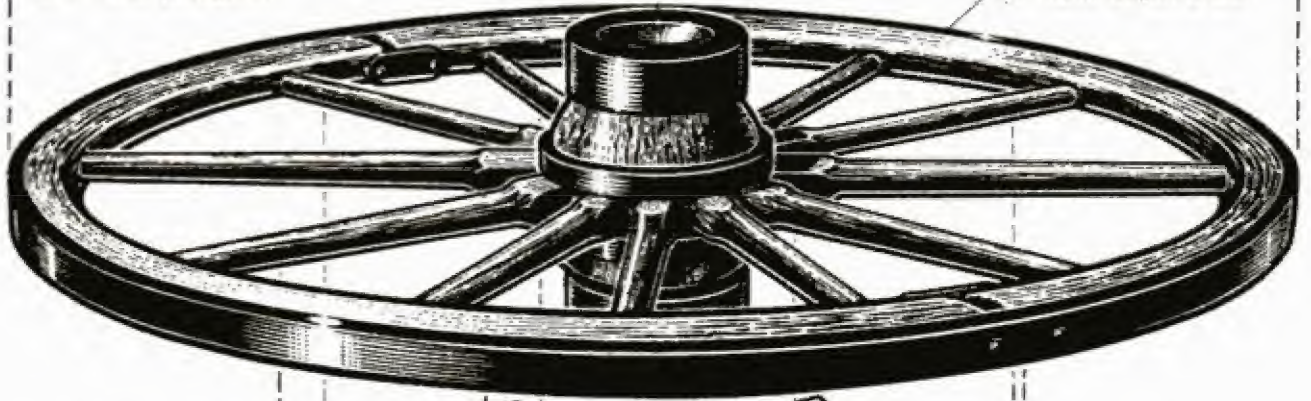


Plastic collar
 Glued together with epoxy

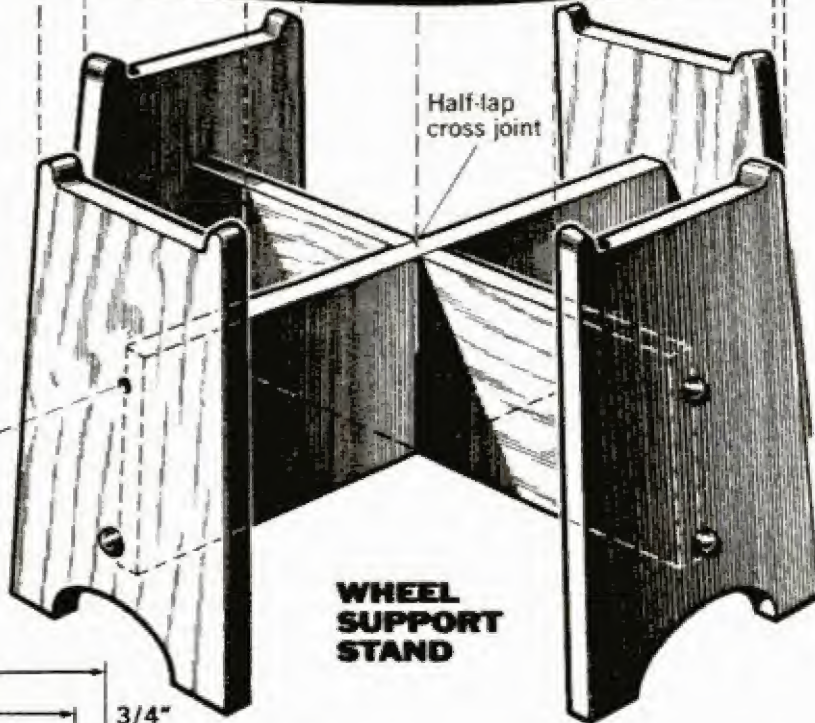


1/4" clear plexiglass

44" farm wagon wheel



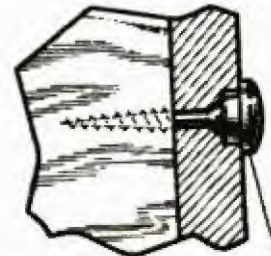
WAGON-WHEEL TABLE



Half-lap cross joint

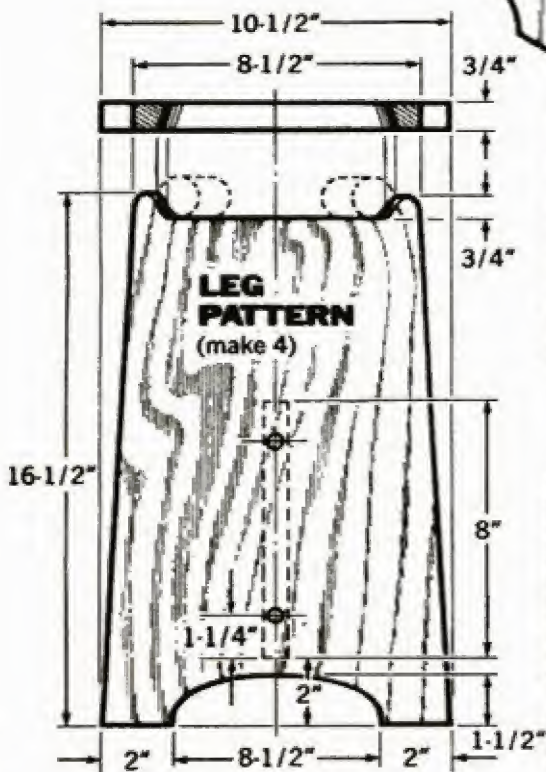
No. 8-2-1/2" FH screw

Wood screw-head button

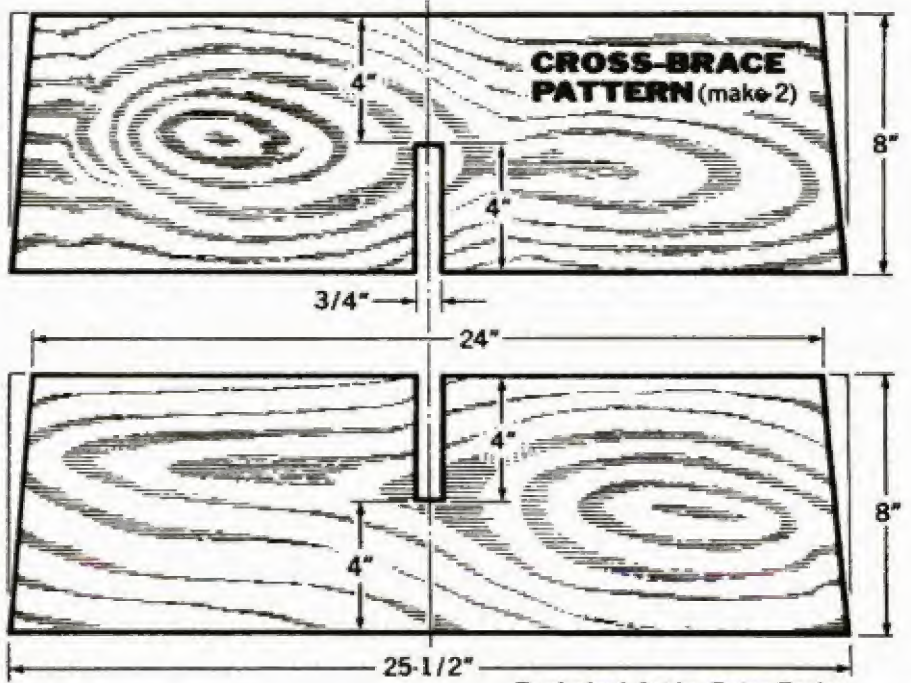


Screwhead countersunk 1/8"

WHEEL SUPPORT STAND



LEG PATTERN (make 4)



CROSS-BRACE PATTERN (make 2)



CROSS BRACES are joined, using a snug half-lap joint. Apply glue generously to the mating surfaces



EACH LEG is marked, drilled and attached to cross brace individually to assure its proper location



COUNTERBORE the legs about 1/8-in. deep to conceal the screw-head, finishing actual assembly

fit the top recess to suit. Cut the slots (half-lap joint) in the two cross-frame pieces to insure a tight fit.

Next, lay the wheel on the floor top-side down. Cover the hub with a square piece of 1/2-in.-thick wood for the frame assembly to rest on. Fit two opposite legs against the ends of one of the cross-frame pieces, make match-marks and scribe the outline of one end on the inside of one leg to serve as a guide for drilling the screw holes through the leg. Drill the screw pilot-holes into the cross-frame end at an angle matching the slant of the leg as it is fitted against the cross frame. Legs must be fitted individually because the spokes may vary. Use glue and counter-bored screws to assemble. Before lifting the assembly frame off the wheel, mark the legs 1, 2, 3, 4 and make match marks on the wheel spokes for alignment later. Give the base the same finish you used on the wheel.

The tabletop. Clear plastic (1/4 in. thick) was used for the top because it's easy to work with (see *How to Work With Plexi-*

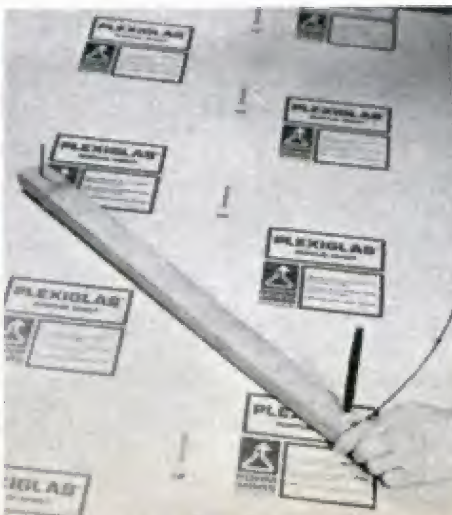
glass, page 176, June '70 *PM*), is durable and gives the glasslike look this table needs. First, draw the center circle just large enough to fit the hub. (Do not make the cutout at this time.) Then outline the circle's circumference (as shown). You can now cut both circles sawing the larger one first.

Lay the tabletop on the wheel and measure the distance between the plastic and the points where spokes go into the hub at the center. (The outer edge of the plastic is supported by the rim which is higher than the spokes at the center.) At the hub, it will need support. A plastic collar around the hub resting on the spokes gives that support. Make it by cutting two strips of plastic to the necessary width and half the length of the hub circumference plus 1/2 in. With masking paper removed, place the strips on a cookie sheet and heat in a 200° oven until pliable. To shape the strips, bend them around the cutout of center hole and file the ends at an angle to butt against each other. Finally, glue the two together with epoxy. ★★★

SCREWS are hidden by turned buttons, or you can use dowel ends cut to fit and then sanded flush

COMPASS for marking top circumference is strip of wood with holes drilled for nail and pencil

SUPPORT COLLAR, on which top rests at center, has two shaped plastic strips glued together



HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Frost-clogged chimney

I'm building my small home and living in the basement. I have an oilburning space heater vented to a temporary "block" chimney capped with a clay chimney pot. In cold weather the flue fills with frost which gradually builds up until the burner goes out, often with a loud "bang." In warmer weather the frost melts and runs into the basement through the smokepipe opening. What causes this? What's the remedy?—N.Y., Minn.

One of the products of combustion of concentrated fuels is water vapor. When the burner is operating you will see what appears to be "smoke" issuing from the chimney pot. But this is not smoke; it's water vapor. When the temperature is much below freezing this tends to collect in the flue as frost. This builds up to narrow the flue opening and eventually causes the burner to "plop" out. You are fortunate the burner has not "exploded" and caused you more trouble. Probably you have the pipe damper—on some installations this is an atmospheric damper—very nearly closed, thus releasing minimum heat to the smokepipe and flue.

Usually you can prevent this buildup by opening the turn damper half way, or a trifle more, to release more heat to the flue and prevent frost from forming. If the damper is of the atmospheric type, set it to remain more nearly closed, which will have essentially the same effect. A little experimenting will determine the best setting for either damper.

Leaky shower stall

My basement shower stall has a concrete rim 5 in. high, is neatly curved at the corners and encloses a floor space about 30 in. square. Plastic curtains form the enclosure of the stall. This rim is cracked away from the floor and water runs out on the floor when the shower is in use. Any suggestions?—E.C., Nev.

Ordinarily, new concrete will not bond to old and this, undoubtedly, is the cause of leakage at floor level. Rather than break up the present rim and replace it, first raise it 5 or 6 in., clean away dirt and loose particles and lay two or more lines of caulking under the rim. Then lower the

rim onto this, pressing it down all around to spread the lines of caulking evenly. If you can do this without breaking the rim, the leakage may be halted.

Otherwise, you might break up the present rim, drill holes in the concrete floor to take lead screw anchors, then turn long round or flathead screws into the anchors, allowing the heads to project $\frac{3}{4}$ or 1 in. Then make a form and pour new concrete, preferably using hydraulic cement in a sand mix. The projecting screws should hold the pouring in place.

Installing a bathroom fan

I want to install a ventilating fan in my bathroom but I'm confused about whether to place it in the ceiling or in the wall. I thought the ceiling was the logical location but I'm told it makes little difference. Can you set me right?—L.A., Miss.

Natural convection of warm, moist air would be through the ceiling, of course, but when you install a fan these conditions are altered somewhat. The fan exhausts a given amount of air from the room in a given length of time according to its rated capacity. Assuming that the bathroom is of average size, that one side is an outside wall, and that other governing factors are average, you would put the fan wherever installation would be easiest: in the ceiling or in the wall, preferably near the ceiling. Ordinarily, you'll get efficient operation either way. If the fan is installed in the ceiling, the warm, moist air should be conducted to the outside through a duct, rather than exhausted into the attic where the moist air might create a condensation problem.

'No-see-through' window screens

I understand there's a way to treat window screens so that persons outside the room cannot see inside. Can you describe how it's done?—D.S., Mich.

One way is to paint the inside of the screen black and the outside white. First, the screen must be scrubbed with a mild soap solution, hosed down to remove all loosened dirt and debris, and allowed to dry. Apply the black paint lightly to the inside of the screen with an applicator made for the purpose, or make one by stapling a piece of carpeting to a small block of wood. Let this black paint dry thoroughly, then apply white paint to the outside of the screen in the same manner. This is effective only during daylight hours; not at night when the room is lighted. ★★★

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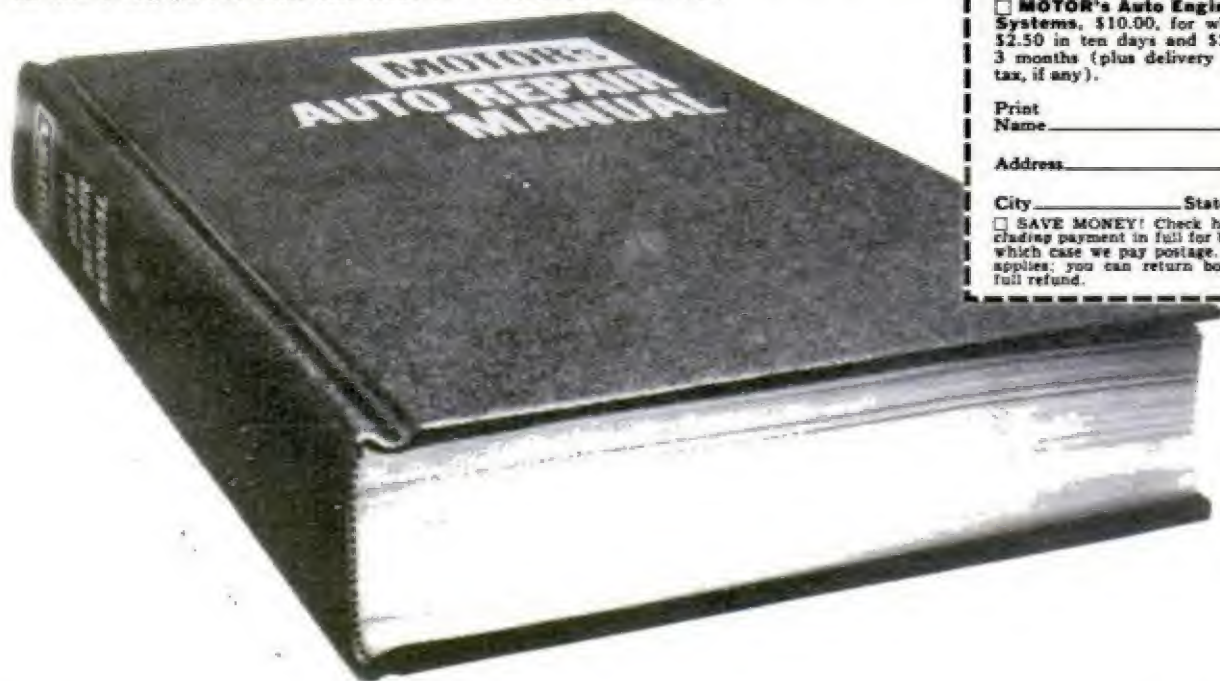
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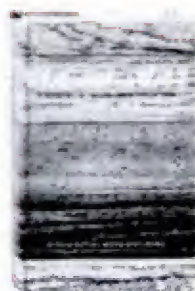
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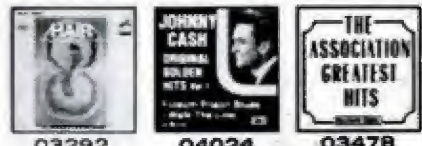
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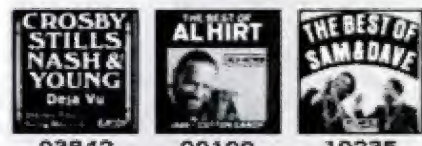
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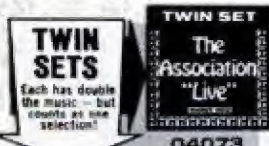
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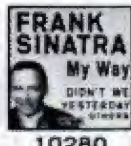
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'71S: PICKUPS THAT PAMPER

(Continued from page 101)

ordered with 4wd. Again, there are wide ranges of H-D options, varying GVWs, box sizes, payload capacity and special-purpose vehicles. International fully realizes the importance of versatility and caters to all tastes.

Cabs can be had with exterior and interior trim packages, sliding rear window, full-width bench seat, airconditioning, vinyl roof, and wood-grain sides. Crew cabs (six-passenger) are available in the 1210 series.

FORD F-100/250/350

Someone at Ford figured out that the company offers 69 different '71 pickup models, *excluding* the Ranchero.

The Torino-based Ranchero continues relatively unchanged this year, using the intermediate's 114-inch wheelbase and much of its sheet metal. Last year there were three different 429-inch V8s; now there are only two. Otherwise, the engine lineup is the same. Rancheros have three model designations: 500, GT and the wood-paneled Squire. Options include everything you can get in a car, even a four-way power seat.

In the regular Ford line are three series: F-100, F-250 and F-350—all with either two or four-wheel drive. The 2wd versions continue Twin-I-Beam front axles and a unique adjustable rear-spring system called Flex-O-Matic. This incorporates a handle to adjust the rear spring shackles for light or heavy loads.

Models are called Custom, Ranger, Sport Custom and Ranger XLT. These become progressively fancier. You get a choice of wheelbases in the F-100 and F-350 and different box sizes in all series. Among Ford pickups' clevernesses are a sliding rear window that opens or locks shut. An electric power-pack option uses an auxiliary, aircooled gasoline engine mounted under the hood of F-100 and F-250 pickups. This drives a 2500-watt a.c. generator to run tools and appliances.

Ford pickups also offer various special camper, heavy-duty, farm, ranch and contractor packages. The F-250 and F-350 can be ordered with power front disc brakes and/or heavy-duty drums.

DODGE D-100/200/300

Dodge's fancy job, the Adventurer, introduced in late 1968, has been doing well ever since. Available in both D-100 and D-200 2-wheel-drive series, it comes in Standard, Sport and Special Edition versions. Among the niceties are added sound-deadening, six-way adjustable seat,

door pockets, plusher upholstery, nylon carpeting. You can order the gamut of driver-assist and luxury options.

There's a new 1971 Dude—for tough, fast going; not expensive but with distinctive striping and interiors. The A-100 compact pickup has been dropped.

Dodge offers 4wd in all three series, but this changes the designations to W-100, W-200, and W-300. The larger two are available with six-man cabs.

Dodge's 2wd pickups come with "Cushioned Beam" front suspension, which means an I-beam axle with longitudinal leaf springs. The trick, though, comes in putting plastic liners between leaves to remove most interleaf friction, thus smoothing the ride and getting rid of traditional squeaks and groans. Dodge pickups also have front sway bars for added cornering stability and resistance to side winds. You can, of course, get all sorts of heavy-duty suspension mods to fit various loads and roads.

The Camper Special package includes an easy-off tailgate, increased cooling and electrical capacity, and heavy-duty components throughout.

CHEVROLET AND GMC

Chevy and Jimmy pickups have become twins. You can still tell them apart by their grilles and trim, but otherwise they're virtually identical. Both pickups use the same engines, although Chevrolet offers three more horsepower ratings. Both offer three series in three trim groups, also three different wheelbases (see chart).

Most notable addition to 1971 Chevy and GMC pickups are standard disc brakes. These make long downhill runs a lot safer, especially with heavy loads, because discs resist fading much more than drums. Discs also aren't affected by water. Both GMC and Chevrolet include a vacuum booster with all but half-ton pickups; it's optional on those. Front-rotor diameters are 11.86 inches on half-tonners; 12.5 inches on $\frac{3}{4}$ and one-ton models. A delay valve correlates front-disc application with that of the new, finned rear drums. A proportioning valve balances brake pressure front-to-rear, regardless of load. With the better braking, all GMC and Chevy pickups get wider wheels.

Variable-ratio power steering is optional on 4wd models, with a two-speed transfer case standard on GMC 4wd pickups. Four-speed floorshift gearboxes are standard on one-ton versions; optional on others. Airconditioning and those other comfort and camping options are available. ★★★

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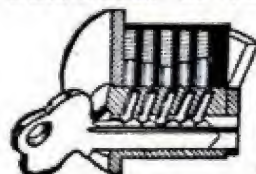
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HONEYMOON ON A HOUSEBOAT

(Continued from page 105)

of movement, space and working opportunity on a houseboat is unparalleled in any other kind of family conveyance, even including a motor home. I'm sitting, relaxed, writing, reflecting on the green and gold of the Arkansas bluffs moving by while snacking on cake and coffee. Do that on water with any other design of comparable size, and you might end up with coffee in your lap! This is honest leisure."

We arrive after dark at the Ramada Inn Marina near Dardanelle. Charlie Smith meets us, and we're off to dinner at Russellville's Marina Restaurant. Imagine, genuine Thai food in the Arkansas heartland!

Next morning Jack Seastrom and his wife, Carolyn, join us. Jack wants to show us the Kenner plant at Knoxville and since neither he nor Carolyn has seen the river above Dardanelle, they ask to hitchhike on the rest of the run to Fort Smith.

Dardanelle Lake is pretty and we could spend days doing nothing but fishing for greedy largemouth bass in just one of its tributaries, Big Piney Creek. And if we tire of angling, we could shoot trap off the houseboat roof or take a Kenner Ski Barge into the tiny creeks nearby.

Finally we push on through soft, rolling countryside as we near the Oklahoma border, and we can see even farther from the river. Not that the river itself doesn't offer scenery enough: we're always sighting birds, most notably a bald eagle sitting near the houseboat and a flock of white pelicans on a sandbar.

We make Fort Smith in fine time and celebrate with an excellent seafood dinner (fresh from the Gulf) at Jimmie Little's. When Jack and Carolyn turn downstream for the run back to Knoxville, Barbara and I long to go with them. While a mite cramped for permanent living, the Suwanee 35 proved a perfect weekender and a memorable honeymoon boat.

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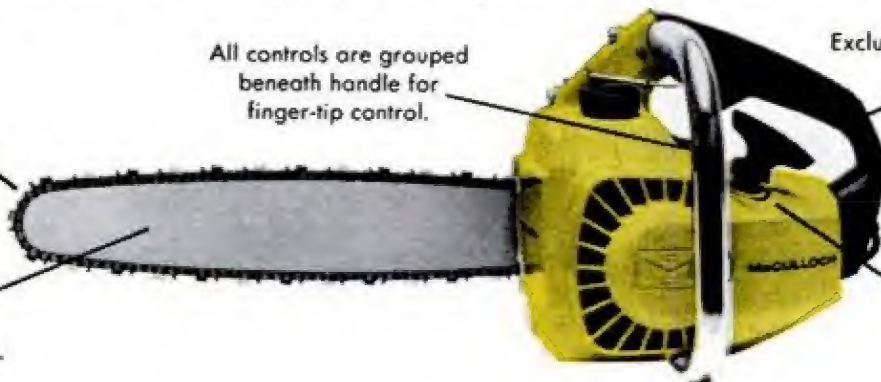
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(Continued from page 107)

Park. These include an inspection of all "privately-owned over-sand vehicles" and issuance of a permit. The following equipment is required by law: jack, shovel, tow-rope or chain, and board or similar jack support. Camping is prohibited, which is the case on most beaches. (You'll find that nearby campsites are usually provided, however.)

Many ingenious devices utilize all available beach-buggy space. Roof boxes are mounted on carriers and hold an assortment of tools, tackle and fresh water. Rods are carried in front-bumper rod holders and even outboards are mounted on the bumpers while small, light boats are carried on the roofs for launching in mild surf when the fish are feeding beyond casting range.

Driving problems on the beach are best avoided with a little common sense. Never park below the high-tide mark, and it's unwise to drive below it. A mechanical breakdown, even a flat tire could be disastrous in an incoming tide. Follow the Jeep trails on the high and dry side and watch out for driftwood with tire-piercing nails. Big tires are better than small ones, and they should be deflated in deep sand. (Tube tires are better than tubeless ones for this reason.) Remember that your vehicle will ride on a highway most of the time, and tires must serve a dual purpose. The regular tread will do, although I prefer the mud and snow treads for year-round use.

If you get stuck, avoid digging in. Shift to low gear, deflate the tires to minimum pressure, straighten the wheels and shovel a path for them. Then ease out by rocking back and forth. There is no bottom to beach sand and spinning wheels won't help. If one wheel gets a grip, chances are you can grind out. If you're sunk in wet sand or quicksand, bumper jacks and planks are a must. A tow is even better, and you'll discover that most beach buggy men are helpful compatriots who never know when it might become their turn for assistance.

Deep sand, eroded gullies and traps require a firm hand on the wheel. Loose sand on a slope may cause the buggy to sideslip. Hillocks and eroded dunes are treacherously deep and may cause the vehicle to stall. Turning 180° should be done by backing rather than circling; crossing ruts can be difficult.

Most driving is in low gear, and remember: The beach is a close relative of the sea, and like the sea, it should always be treated with caution. ★★★

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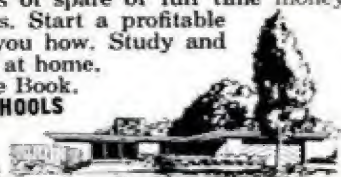
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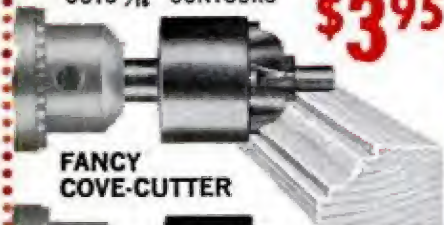
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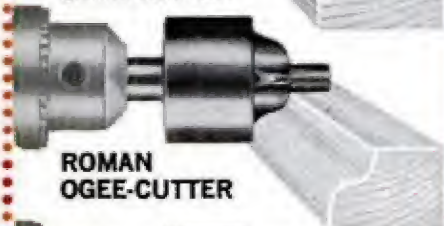
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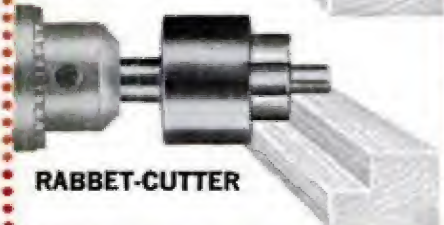
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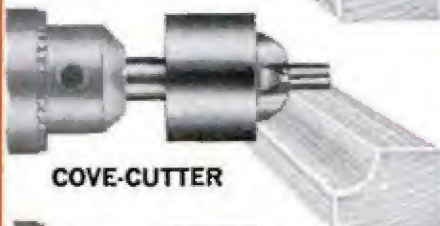
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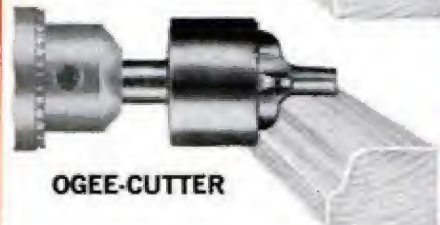
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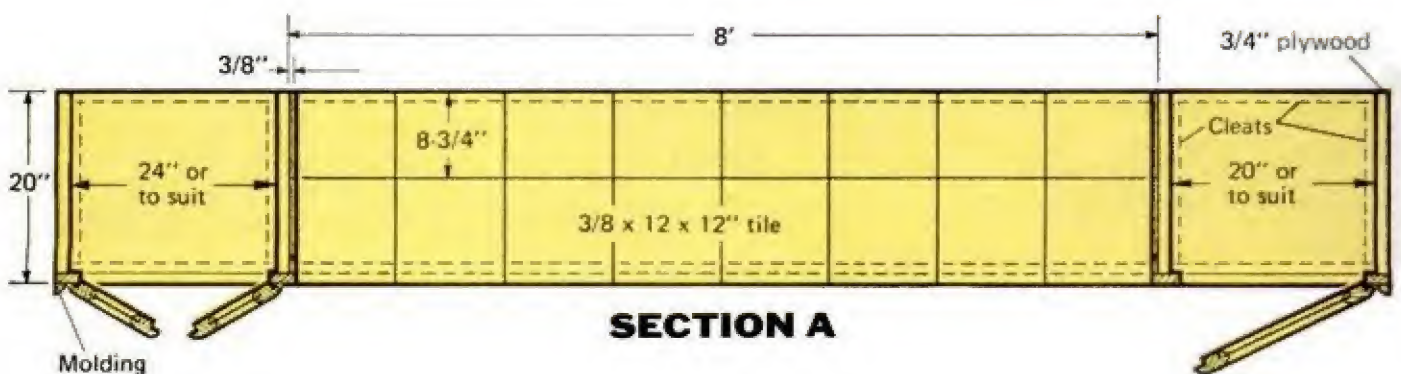
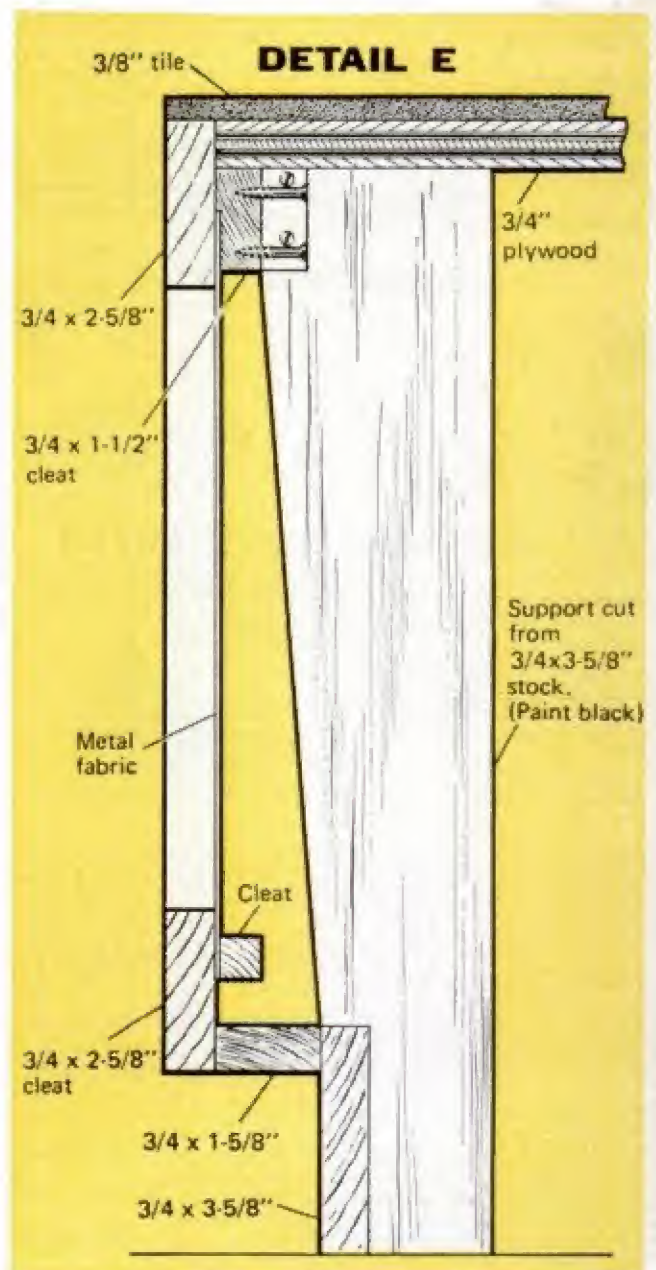
(Continued from page 141)

itself must be covered with a relatively open grille. Before enclosing the radiator, spray it with black paint and it will be virtually invisible behind the brass screen. *Another tip:* Line the wall behind the radiator with two layers of kitchen-type foil (or a piece of sheet aluminum). If you use the former, make certain that both layers are glued securely to the wall, or the moving, heated air will cause "crinkling" noises. The foil effectively reflects and bounces the maximum amount of heat into the room.

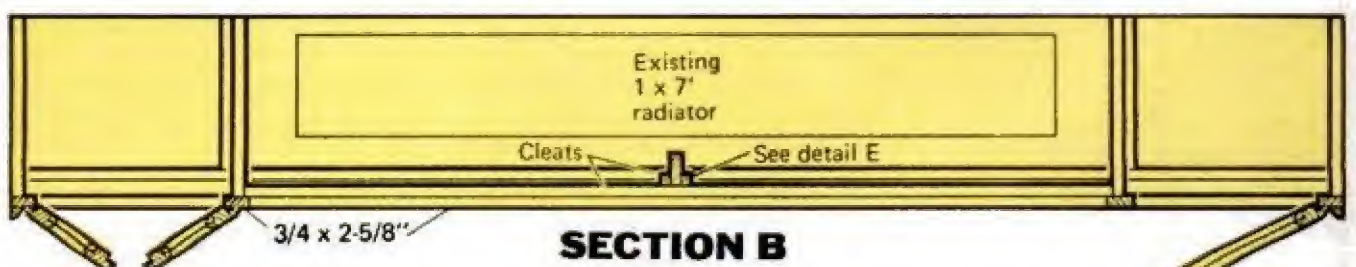
The cabinets are easy to build; no fancy or intricate cabinetry was employed here. And to make the job even easier, I utilized discarded, inexpensive kitchen-cabinet doors. Your local kitchen-cabinet contractor will gladly sell you all you need at nominal cost since any kitchen remodeling job he tackles requires removing the old cabinets anyway.

When you have your cabinet doors in hand, lay out the cabinet frame to suit the door opening sizes. The inserts are a matter of personal choice but we chose to stick with brass grille throughout. A trip to your local lumberyard will reveal an almost staggering variety of grilles and plastic inserts that are available at relatively low cost.

If you're using doors removed from old cabinets, you'll first have to remove the plywood inserts by routing a rabbet around the frames on the rear side. This will let you lift the wood inserts and replace them with decorative brass grilles. ★★★



SECTION A



SECTION B

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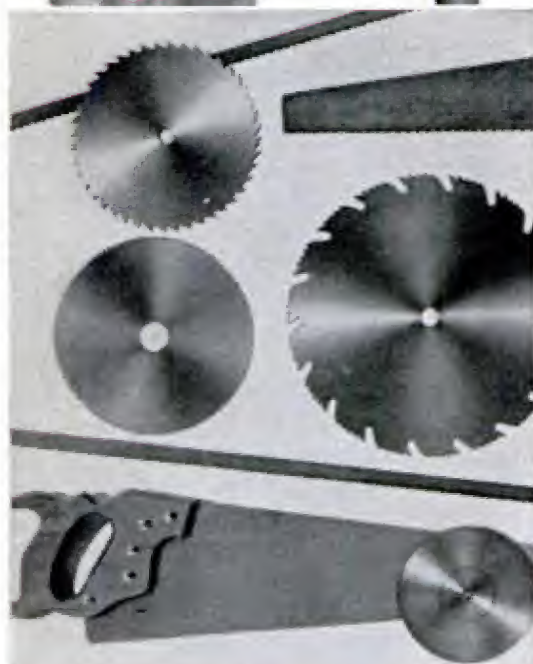
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Here's the story from Dick and Jo Ann Koester after being in business less than a year. "We have acquired another Foley Saw Filer and for the past two months we have been in full-time operation. As we live in a small town of 150 population in farm area we use our truck to pick up saws in five nearby towns. With a family to support and plans for building to our house we had to pick up a business fast and already sharpen an average of 15-20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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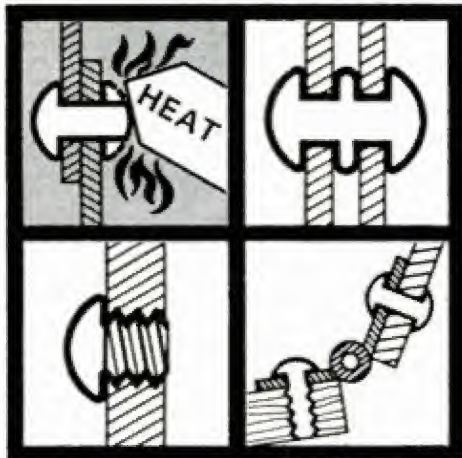
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FROM VAN TO CAMPER—\$340

(Continued from page 152)

manner around the extension at 1-ft. intervals. Use both epoxy and bolts with lock washers and nuts to fasten this roof securely in place.

To finish the open corners, cover them with heavy wire screening. Screw the screen to the roof in several places. This will serve as a base for the fiberglassing. Finally, cover the entire new roof with fiberglass resin, and cover the screen molds and all edge joints with fiberglass cloth and resin. Take special care that you cover the joint where the new roof meets the body. We used four coats of acrylic enamel to finish the outside. If you paint the roof a light color, it will reflect sunlight and keep the van cooler during the summer months.

The interior can be completely designed and appointed to suit your own taste and needs. But try to use the existing steel spars as much as possible to support any additions. Another hint: Plan your design to keep the center of gravity as low as possible.

If desired, you can supplement existing spars, by adding a framework of 2x4s to the body with epoxy.

Along the left wall we built a 20x60-in. counter topped with a laminated particle board. Here we placed an LP-gas stove, sink with food strainer (for drainage we used a PVC pipe that leads from the sink through the floor) and a hand water pump.

The 20-in. space behind the driver's seat is filled by a food closet designed with an ample number of shelves.

When you have decided where to place all your fittings, you can install the fiberglass expandable insulation (with vapor barrier) throughout the interior—on all walls and the ceiling. We used about 180 sq. ft. The wood paneling which is bolted to the steel body spars, and screw-fastened to the roof 2x4s, holds the insulation in place.

Other items we added include an AM/FM radio with front and rear speakers, high-intensity electric light as well as a gas lantern, a chemical toilet, a two-speed fan, carpeting and an all-door and engine-compartment burglar alarm. All the equipment that we installed was bought at either a local camping supply store or from Sears.

The total weight of the converted van is 3900 lbs. It cruises at 65-70 mph and averages about 14 mpg, even with the air-conditioning running full blast. Actual building time was about 70 concentrated hours.

★★★

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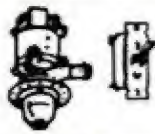
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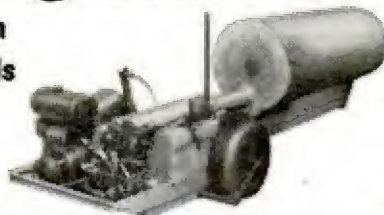
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COLLISION-AVOIDANCE SYSTEM

(Continued from page 93)

keep the hits. Breckman says that's what he's done.

The box is called, simply enough, a processor. Other primary parts of SECANT are a remitter (compound of the words receiver and transmitter) and a prober.

To interrogate its environment, an aircraft transmits a probe-pulse, which is a short burst of radio-frequency energy. All aircraft receiving a probe acknowledge by transmitting a return pulse. Probes and returns are on a one-to-one basis—one return sent for one probe received.

Since all aircraft are interrogating and responding at the same time and over the same frequencies, without synchronization, it now falls on the processor to separate the meaningful signals from the fruit. It succeeds in doing this, essentially, by measuring the strength of the received signals.

Weak signals are fruit. They're being transmitted by distant aircraft, which pose no collision threat. But strong signals indicate an aircraft which has intruded into prohibited air space.

These signals are fed to direction-finder equipment that finds the intruder and calculates its angle of approach. If aircraft are on a collision course, instruments in the cockpits of both planes sound a signal to tell pilots what evasive action they should take.

Today, SECANT consists of a feasibility study and laboratory model. The first prototype is being built and is targeted for testing in May, 1971.

"We'll be glad to take a look at it when it's ready," Osmun says.

Until then, ATA feels that it has found the best answer to the collision problem—for the time being anyway. And that's time-frequency. ★★★

RING LIGHT AROUND YOUR LENS

(Continued from page 87)

with, but it should not be purchased as a substitute for a regular flash. Prices for those shown here are \$49.50 for the Honeywell Prox-O-Lite, Honeywell, Inc., 4800 E. Dry Creek Rd., Denver, Colo.; \$49.95 for the Aimes-Hershey Sun Ring, Aimes Industries, Inc., 2231 Lockport Rd., Lockport, Ill.; \$59.95 for the Prinz Minicam, Bass Camera Co., 179 W. Madison St., Chicago, Ill.; and \$82.50 for the Nikon SR-1, Ehrenreich Photo-Optical Industries, 623 Stewart Ave., Garden City, N.Y. ★★★

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- 100 MICRO AMPERE METER that will deflect when audio signal is not detectable included in Metermaster along with extra diode and sensitive, full view meter.
- HEAVY DUTY ANODIZED TELESCOPING ALUMINUM TUBES with single lock nut to set best length for user's height, adjustable from sixteen to thirty inches.
- COMPLETELY WIRED (not a kit and no radio necessary for operation).
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- ATTRACTIVELY STYLED high impact molded case and Search Heads balanced for long use.
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OPERATING PRINCIPLES

Operates by comparing the frequencies of two colpitts oscillators and amplifying the audio frequency which is the sum of the difference. The fixed oscillator is controlled by the thumbwheel tuner. The variable oscillator changes its inductance when the Search Head is brought into close proximity of any metal. This difference when amplified is heard in the earphone or speaker, as an audio signal tone.

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(Continued on next page)

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(Continued from preceding page)

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(Continued on next page)

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(Continued from preceding page)

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1971 SURPLUS Army, Navy store illustrated catalog. Send 50¢ (refundable with first \$5.00 order). Ruvel, 3037 North Clark, Dept. 2-J, Chicago, Illinois 60614.

JEEP And Gov't. Surplus Buying Manual (Jeeps Pictured) 50¢. Surplus Bargain Catalogue 50¢. Both \$1. Surplus Bargains, Box 789PM, York, Penna. 17405.

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(Continued on next page)

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(Continued from preceding page)

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(Continued on next page)

BUSINESS OPPORTUNITIES

(Continued from preceding page)

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ADDRESSERS And mailers needed. Send stamp for information. Lindbloom, 3636 West Peterson, Chicago 60645.

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(Continued on next page)

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(Continued from preceding page)

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(Continued from preceding page)

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\$500-\$800 MONTHLY Raise small Laboratory-breeding stock for us. We supply equipment, breeders, and instructions. Illinois Research Farms, Dept. MPA-2, Barrington, Illinois 60010.

EARN \$240.00 A month at home, spare time, doing only two \$5.00 invisible mending jobs a day. Big money paid for service that makes cuts, tears disappear from fabrics. Steady demand. Details free. Fabricon, 1586 Howard, Chicago 60026.

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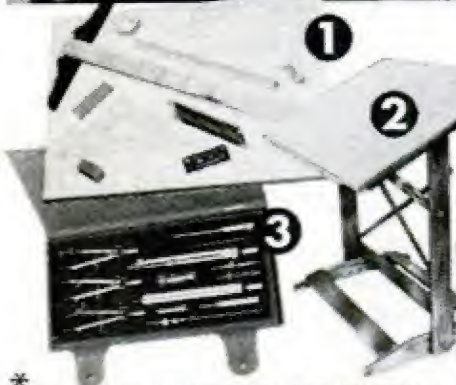
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